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AMERICAN RAILWAY JOURNAL.

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Compound Locomotives on the Chicago & South Side Rapid Transit R. R.—The Industrial Development of the Schuylkill Valley, Pa.—Proposed Re-Armament of the National Guard—Cheap Railway Construction in England—The Late Columbian Celebration in New York—Steam Distribution in the Westinghouse Compound Engine.

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Railways, Electric Railways, Elevated and Cable Railways, Horse and Motor Railways, Highways, Bridges, Tunnels and Canals, Water-Works, Irrigation, Sewers, Streets, Electrical, Contract Prices, Miscellaneous. Manufacturing and Technical, Current Price List.

The hydraulic mining opinions, handed down by Judge W. B. Gilbert, of the U. S. Circuit Court, of California, enables the North Bloomfield Gravel Mining Co. to resume work after a long suspension. This opinion, boiled down, means that a reasonably tight dam, making an impounding reservoir for the washings from hydraulic mining, will protect the river below from injurious silting. Judge Gilbert says that the water that escapes through the lower cribs of the dam in question is discolored by finely comminuted clay held in suspension. The sand and heavier particles have settled to the bottom in the dam above, and this fine clay will remain in suspension and be carried to an indefinite distance so long as the velocity of the water is not less than two miles per hour. In these mines the debris is carried down a shaft 90 ft. deep into a tunnel 3,000 ft. long leading to Canyon Creek. About one-quarter mile below the tunnel exit is a dam built of cribs filled with stone and backed by brush and small trees. The complaint was that the debris from these mines escaped through this dam in sufficient volume to interfere with navigable channels in the South Yuba, Feather and Sacramento rivers.

A 45-in. refracting telescope is to be made for the Chicago University by Alvin G. Clark, of Cambridgeport, Mass. It is the gift of Mr. Charles T. Yerkes, of Chicago, and the estimated cost is said to be $500,000 in all. As the Lick instrument, the largest in the world, is only 36 ins. in diameter, the new lens will far exceed its predecessors in power.

The telephone wires of Cincinnati, O., are to be taken from the streets, and made to radiate from poles placed in the center of blocks connecting with the underground system at the foot of the poles. In this way no wire will cross a street. The distributing poles will be provided with a platform near the top supporting an iron ring, equipped with 104 insulators. A cable will be led from the main subway, by a smaller conduit, to the foot of the pole and then up the pole to a point opposite the distributing ring. The terminal head holding the feed wires is covered by a galvanized iron hood, raised by a pulley above it. From under this hood 100 wires will pass, gathered into 5 cables, to the edge of the bottom floor and then up to the distributing ring. These poles are the device of Mr. W. H. Robinson, Superintendent of Construction of the telephone company.

An electric block system is in use on the Rochester, Pa., electric railway, a single track line about four miles in length, which was opened for business Aug. 13. At each passing siding is located a signal box containing two groups of lamps, each group consisting of three lamps of 16 c. p. each. These lamps are wired in series of six, the three lamps in the upper half of one box being connected directly with the three lamps in the lower half of the next box about 4,000 ft. away, and are supplied by a current of about one ampere, taken from the trolley wire, and carried by a No. 12 galvanized iron wire, in order to get the resistance necessary. Each box is equipped with two three-way switches for turning off the lights, or turning them on as the car enters the section. The cars going in one direction are blocked by lamps burning in the upper half of the boxes, and in the other direction by lamps burning in the lower half of the boxes.

Passenger cars heated by stoves are refused in interchange by the New York, Lake Erie & Western R. R. A circular recently issued giving notice of this quotes the New York car heating law as the reason for this step. The Erie officials evidently propose to run no risks by hauling stove-heated cars from their connections.

Brakes are being placed on the truck wheels of passenger locomotives on the Old Colony R. R. by direction of Superintendent of Motive Power J. N. Lauder. This is probably a result of the disaster on the Old Colony at Quincy, in August, 1890. The insufficient braking power on the train which was wrecked at that time was fully shown in the Railway Commission's report. Since that time, Mr. Lauder has been converted to the idea that driving-wheel brakes should be applied to all engines and should be operated by the same handle that applies the train brake; and he also holds that a brake shoe should be applied to every moving wheel in the train, even to the engine truck wheels. The only objection to this is the possibility that the truck may be somewhat more liable to derailment with brakes on the wheels. That this would be the case is, we believe, the opinion held by a few master mechanics; but it is purely a matter of opinion and no one knows or can know until we have the results of experience for a long series of years whether any such increased tendency to derailment actually exists.

The most serious railway accident of the week was a head collision Oct. 14 at Harrisons Landing, Conn., on the New London Northern R. R. The fast freight train for Boston, which left New London, Conn., at 5:40 a. m., ran into the southbound Brattleboro freight train. Five men and four racehorses were killed. The accident is attributed to the operator at Norwich going to sleep on duty, and allowing the southbound train to pass. When called up by the operator at New London he replied that the train had not arrived and the Boston train was therefore allowed to proceed.—A serious derailment accident occurred Oct. 9 near Eden, Colo., on the Atchison, Topeka & Santa Fe R. R. A freight train was derailed by running over a cow, and the engine and eight cars were wrecked. Three men were killed.

A grade crossing collision by which a cable car was smashed by a freight train occurred Oct. 12 at the 15th St. crossing, Kansas City, Mo. Four persons were killed. The flagman was in his shanty putting away his lamps, and the gripman did not wait for him to signal if the track was clear.

A burning trestle near St. Joseph, Mo., on the Kansas City, St. Joseph & Council Bluffs Ry. gave way under a stock train Oct. 10. The engine, tender and one car got across, but the second car jumped the track, derailing the other cars, all of which went down. About 80 cattle were killed.

Blizzard weather in the Rocky Mountain region commenced on Oct. 11 with rain, sleet and wind. Denver was torn up and electric light, telephone, telegraph and trolley wires were mixed in a deadly confusion, and three horses were killed by the electric current. Trains were blocked on the South Park branch of the Union Pacific, Fort Worth and Rock Island systems, and snow plows were operated on from 3 to 7 ft. of snow in the cuts.

The exclusion of the sewage of Chicago from its drinking water has recently been reported on by members of the Sanitary District Trustees, and those associated with them. The report was made upon request of the Trustees for a plan which would give relief during the construction of the drainage canal.

The report states that of a population of 1,505,000 the sewage of 270,000 is continuously discharged into the lake, while the sewage of enough more goes into the lake, when the Chicago River flows lakeward, to bring the population contributing to foul the lake up to 1,483,000. Whenever the flow of the Des Plaines River exceeds 40,000 to 60,000 cu. ft. per minute, says the report, the river overflows to the west arm of the south branch of the Chicago River. In June, 1892, the flood flow of the Des Plaines River reached 810,000 cu. ft. per minute at Riverside, and of the Chicago River, 702,000.

The report recommends that the Desplaines River be shut off from the Chicago up to the 300,000 cu. ft. per minute point; that a part of the drainage from the headwaters of the North Branch of the Chicago River be diverted into the lake; and that the pumping facilities and capacity of the Illinois & Michigan Canal be increased so that from 100,000 to 120,000 cu. ft. of sewage laden water may be diverted from the Chicago River and thus from the lake.

Philadelphia is about to create a loan of $1,000,000, to be expended in the construction of main sewers. Director of Public Works Windrim wants $600,000 for this purpose for next year. His schedule submitted to the Committee of Surveys calls for a total expenditure of $1,600,500.

Collapsible cylinders for raising sunken ships are the subject of a patent granted to the Grant Bros., of Tacoma. As near as can be now learned, they expect to introduce cylinders of canvas, treated with beeswax and rosin inside the sunken hull, and to expel the water by inflating the cylinders with air. They expect in this way to be enabled to float almost any ship in which the hull is not too badly shattered. Attempts have been made long ago to lift vessels by means of air-bags or "camels"; but their claim rests upon displacing enough water from the inside of the hull to enable the ship to float itself. Some successful preliminary tests have been made.

The official opening by the Long Distance Telephone Co. of a direct line between New York and Chicago, 950 miles in length, was appropriately celebrated at the New York and Chicago offices on Oct. 18. A cornet at the New York end of the line played "The Star Spangled Banner," which was listened to by those assembled at the Chicago office. A cornet at the Chicago end then played the same tune to the listeners at New York. A conversation followed between Mayor Grant of New York and Mayor Washburne of Chicago, and afterward Prof. Alexander Graham Bell at the New York end talked with Mr. Wm. Heafford, of Chicago. Mr. Heafford was the gentleman with whom Prof. Bell talked, over the telephone line exhibited at the Centennial Exposition in 1876, and curiously enough he had never seen or talked with him since.

This is nearly double the length of the longest telephone circuit abroad, that between Paris and Marseilles, 500 miles, and far exceeds anything which has been done in this country. The circuit consists of a single No. 8 copper wire and runs via Easton, Pa., to Harrisburg and thence via Altoona, Pittsburg, Youngstown, Maumee, and South Bend.

The New York automatic coupler law requires all engines and freight cars owned by corporations operating railways within the state to be equipped with automatic couplers before Nov. 1, 1892. Most of the railways of the state have united in an application to the Railroad Commissioners for an extension of the date on which all cars must be equipped with automatic couplers for one year, to Nov. 1, 1893. It is manifestly impossible for them to complete the change according to the requirements of the law before the end of the present month.

The Chicago Economic Fuel Gas Co. announces that natural gas is now piped to Chicago, and that it will be ready to commence the supply of fuel gas for household purposes within a month. The company announces that it will change an ordinary coal-burning grate to a gas-burner for $9.50, and that it can be operated to its full capacity for 5¼ cts. per hour. For a cooking range the estimated cost of operating with gas is 4½ cts. per hour, and a room-heating stove would cost 1 3-5 cts. per hour. The plant of the company includes 600,000 acres of land in Kokomo oil and gas district of Indiana, and the gas is conveyed to Chicago by two independent 8-in. pipes. The claim is made that 16,000 cu. ft. of gas, costing $8.00, will develop as much heat as one ton of coal. It is, therefore, recommended on the score of convenience rather than economy, in continued use.

A tunnel under the Duluth Ship Canal is recommended by the Board of Public Works of Duluth, Minn., in place of the drawbridge authorized by the Minnesota Legislature in 1889. The Board has had submitted to it many bridge plans, and they conclude that any feasible bridge will cost $400,000. As the proposed tunnel is estimated to cost $600,000, the Board considers it would be wise to expend this larger amount in view of the benefits and decreased cost of operating.

A scheme has been proposed, according to a press dispatch, whereby it is said that the Columbia River would be shortened by 100 miles and the irrigation of 2,500,000 acres of land made possible. The plan is to build a ship canal 60 miles long which would cut off 18 rapids in the river. The diversion would begin in Township 28, Range 13, Washington, and extend to the Grand Coulee, below Priest Rapids. D. A. Scott and T. W. Goddin are mentioned as interested in the project, but no addresses are given.

VENTILATING PLANT AT THE BALTIMORE AND POTOMAC TUNNEL, BALTIMORE, MD.

The accompanying illustrations show the ventilating plant which is now in process of construction at the Baltimore and Potomac tunnel of the Pennsylvania R. R. in the city of Baltimore. The tunnel was built in 1871-73 and connects the Northern Central and the Philadelphia, Wilmington & Baltimore lines with the Baltimore & Potomac R. R. (all parts of the Pennsylvania R. R. system). The section of the tunnel on which the ventilating plant is to be put in operation is 3,600 ft. between portals and is on a grade of 1.35%. The tunnel has a semicircular arch and is 27 ft. wide and 22 ft. high above the rail level.

The principal novelty in the design of the plant is the use of electric power to operate it, current being transmitted from a power house a little more than half a mile away (3,200 ft). The power house contains a steel boiler of 100 HP., a 90-HP. engine and an 80-HP. Thomson-Houston dynamo. A copper cable transmits the current to the motor house, a plain, one-story brick building about 20 × 22 ft., placed close to the base of the ventilating stack. Here is located a 45-HP. Thomson-Houston motor, which is belted to a large pulley on a countershaft. A small pulley on this countershaft drives a large horizontal pulley on the vertical shaft of the fan by means of a half-twist belt. Thus the speed of the fan is brought down to about 14 revs. per minute. The fan is a plain Davidson ventilating wheel, 15 ft. in diameter, the velocity of its periphery is 658 ft. per minute. The chute in which the fan is placed is of circular cross-section, 15 ft. 6 ins. in diameter, and is placed centrally underneath the stack, which is 13 ft. 6 ins. square inside. The passage leading from the tunnel to the fan is 15 ft. 6 ins. high and 8 ft. wide with a semi-circular roof. The area of its cross-section is 117 sq. ft. The ventilating apparatus is guaranteed to change the entire air in the tunnel in five minutes. Taking the tunnel cross-section at 415 sq. ft., the volume of air in it is 415 × 3,600 = 1,494,000 cu. ft. This quantity divided by 117 equals 12,796, the length of the air column which must pass this chute to change the air in the whole tunnel. If this is done in five minutes, the velocity will be 12,769 ÷ 5 = 2,554 ft. per minute, or 42.6 ft. per second.

The result of the above calculation enables one to make an estimate of the power required to drive the fan. The resistance offered by the air to the fan's motion arises from two causes—the inertia of the air and its friction in passing through the tunnel and ventilating shaft. Assuming that the air is changed every five minutes, we have 1,494,000 ÷ 5 = 298,800 as the total number of cubic feet of air which passes the fan per minute. The weight of air per cubic foot is .0765 lb. Hence the product, 22,858, is the pounds of air moved by the fan per minute. At the smallest cross-section, the chute leading from the tunnel to the base of the stack, the velocity is 42.6 ft. per second. Hence by the familiar formula $E = \frac{Wv^2}{2g}$, we have the total foot-pounds consumed to give the required amount of air the required velocity per minute,

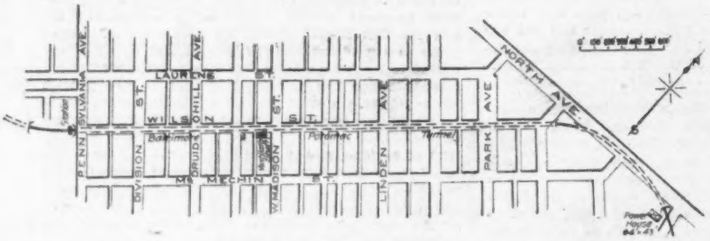
$$\frac{22,858}{64.3} \times \frac{42.6^2}{64.3} = 645,052.$$

Dividing this by 33,000, the number of foot-pounds in a horse power, we have about 19½ HP. as the energy required to overcome the inertia of the air.

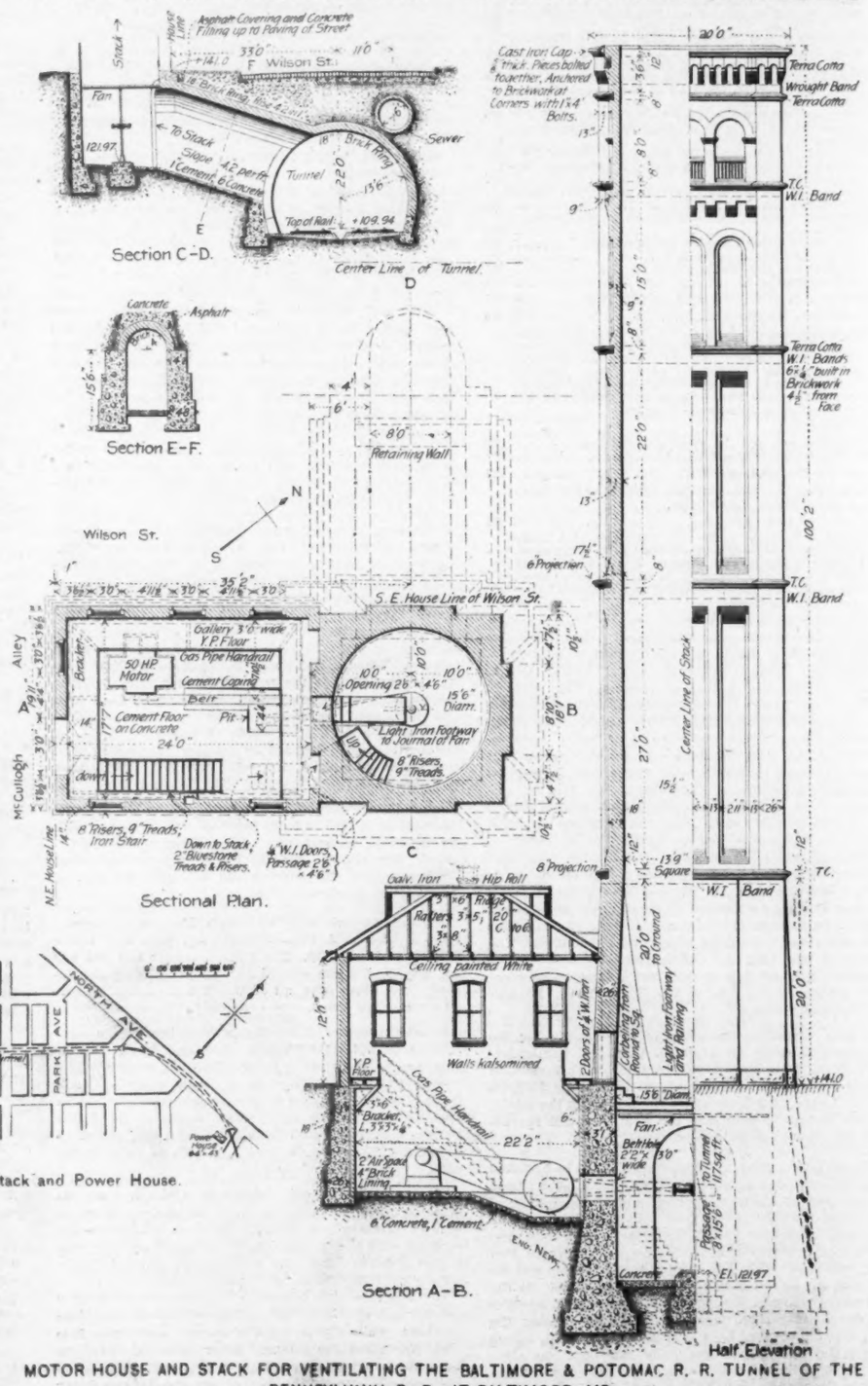
The remainder of the power of the motor is required to overcome the friction of the air by moving through the tunnel and stack, the resistance due to the suction of passing trains, and the friction of the fan itself and of the belts and pulleys which drive it.

The ventilating stack is founded on concrete walls 7 ft. thick at the base and 20 × 20 ft. outside. The dotted lines on the plan show a proposed extension of the foundation conditioned on a satisfactory arrangement with the owner of the adjoining lot. The motor house foundation and wall are built entirely separate from the stack foundation, so that the stack can settle without affecting the motor house.

The mouth of the ventilating stack is 100 ft. above the ground. The stack is built of brick with paneled sides and projecting terra-cotta bands. Considerable pains has been taken to secure a pleasing design for the stack, as will be seen by the drawings. We are indebted to Mr. Jos. T. Richards, Asst. Chief Engineer of the Pennsylvania R. R., for the data and drawings from which the above description and illustrations are prepared.



Map Showing Location of Ventilating Stack and Power House.



MOTOR HOUSE AND STACK FOR VENTILATING THE BALTIMORE & POTOMAC R. R. TUNNEL OF THE PENNSYLVANIA R. R. AT BALTIMORE, MD.

WORLD'S COLUMBIAN EXPOSITION.

(With Inset.)

Intramural Elevated Electric Railway.

The principal system of intramural transportation will be an elevated railway, extending along the north, west and south sides of the Exposition grounds, following the route of the line E indicated on the map published in our issue of Oct. 12, in connection with an article on the transportation question. The plan of having an elevated railway

through the grounds was adopted some time ago, and proposals for the construction and operation of the line were advertised for in January last, but the contract was not awarded to either of the two bidders under this advertisement, which proposals were noted in our issue of March 12. In May, however, other proposals were received (Eng. News, May 26, 1892), and the contract for building and operating the electric elevated intramural railway was awarded by the Exposition management to the Western Dummy Railway Co., of Chicago, and the railway has been named the Columbian Intramural Railway. The company has a capital stock of $500,000 and the estimated cost of construction and equipment of the road is $450,000. According to the contract the company is to pay the Exposition management 25% of its gross receipts, and the fare is to be 5 cts. General Manager, W. E. Baker; Chief Engineer, C. P. Matlack; consulting engineer for the structure, R. I. Sloan, Chief Engineer of the Chicago & South Side Elevated Ry. Co., (Jan. 10, 1892); consulting and designing engineer for the power plant and power station, B. J. Arnold. In July the railway company awarded the contract for constructing the line to Remington & Co., of Chicago, who inform us that the foundations are in for about 2½ miles, and that about ¾ mile of the structure is erected. They expect to have the work completed by December.

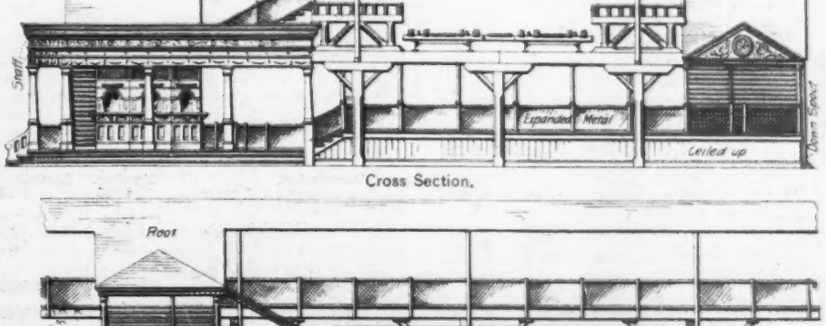
The total length of the line is about 3½ miles, and the profile shows that at the lowest and highest points the track is 20.3 ft. and 33.83 ft. respectively above datum. Most of the stations are on level sections at the summits of grades, the grades being from 0.42% to 1.5% in general, with one short piece of 2%. There are several level stretches, the ground being practically level, and the grades generally introduced to give the necessary headway at roadways, buildings crossed, etc. The height of track at stations is about 12 to 28 ft. above the ground. The curves at the terminal loops are 100 ft. radius, and other curves range from 100 to 2,000 ft., averaging 100 to 300 ft. The southern loop is about 300 ft. from the main steamer landing, near the shore of the lake. The northern loop is just east of the Fisheries Building, with a station on the south side of the lagoon near the Government parade ground. The total length will be 3.6 miles, there being 14,800 ft. of double track and 1,900 ft. of single track. We are indebted to Mr. C. P. Matlack, Chief Engineer, for the drawings from which our illustrations have been prepared.

The structure consists generally of timber bents 25 ft. apart, carrying steel I-beam stringers 15 ins. deep and weighing 60 lbs. per yd. On curves the outer stringers have angle-iron braces. Each bent is composed of wooden posts on which the cap rests and to which it is secured by cast-iron brackets. A plank footway is laid between the tracks. For greater spans, up to 32 ft., the I-beams are doubled. At the north side of the Transportation Annex the track is supported by steel stringers and cross girders on posts 32 ft. apart, conforming to the arrangement of the posts of the building. The posts and caps are of long leaf yellow pine. The single track structure of the loops is of somewhat different construction. Posts generally are 12×12 ins., the caps 12×15 ins. The rails weigh 60 lbs. per yd., and are of the Pennsylvania R. R. standard pattern. The rails and I-beams were furnished by the Illinois Steel Co., of Chicago. There are double timber guard rails 6×8 ins. bolted to the ties, and on curves the outer rail is elevated by a wood plank, and packed guard rails are used. The ties are 6×8 ins., spaced 13 ins. c. to c. at joints and 20⅞ ins. intermediate. Horizontal angle iron bracing is used, as shown on the plan. At joints the stringers have inclined braces built up of two angle-irons back to back, with a web-plate riveted between them. The braces are riveted to the iron shoes shown on the drawing.

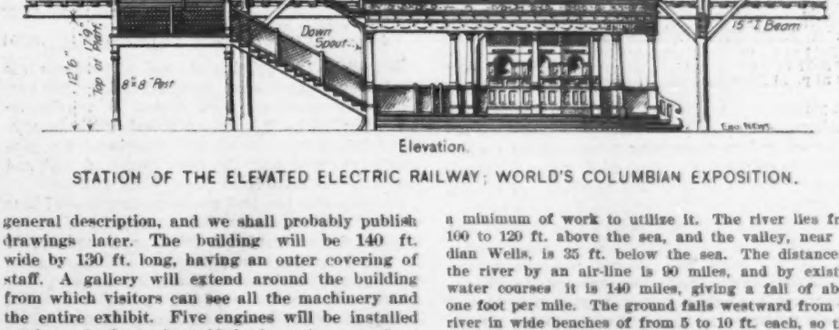
The foundations are of concrete, 7 ft. by 7 ft., and 12 ins. thick under each post, except where extra weight is to be carried. Soft ground was struck near the south end of the grounds, and here the foundations are of timber, spread so as to limit the pressure to 600 lbs. per sq. ft. A general plan of the ordinary foundation is shown on the inset sheet, in connection with the special construction where the line crosses the Transportation Annex.

There will be eleven stations, including one at each terminal. Intermediate stations will consist of little more than ticket offices with stairways leading up to a platform, except the one for the northeast corner of the grounds which is arranged to suit the location. At the loop terminals there will be one platform on each side, joined together at the neck of the loop, where the stairway and ticket offices will be located. All incoming trains will unload on the right hand platform, then run empty around the loop and reload at the other platform. The station at the main railway terminal will be connected with the passenger station by a platform on a level with the second story as shown, and these platforms will be supported on the roof of the trainshed. The station at the terminus of the Chicago & South Side Elevated Ry. will have a connection on the same level as the terminus.

Each train will consist of one motor car and two or three trailers as may be required. Each motor car will be equipped with four 50-HP. Thomson-Houston motors, specially designed for this purpose. The trains can be run on 1½ min. headway, or 40 trains per hour, with an aggregate carrying capacity of 15,000 people per hour. The cars will be built on the same general lines as the cars of ordinary elevated railways, seating about 90 people, except that all seats will be placed across the car, back to back. They are being built by the Jackson & Sharpe Co., Wilmington, Del. The wheel base is shown on the drawings. The power station and power plant will be of special interest and will serve as an exhibit for the General Electric Co. as well as a power station. We are indebted to Mr. B. J. Arnold, consulting engineer of the General Electric Co., of Chicago, and designing engineer of this plant, for the following general description, and we shall probably publish drawings later. The building will be 140 ft. wide by 130 ft. long, having an outer covering of staff. A gallery will extend around the building from which visitors can see all the machinery and the entire exhibit. Five engines will be installed on the main floor, about 10 ft. from the ground, as follows: One 2,000 HP. Cross compound Reynolds-Corliss engine with a 1,200-K. W. Thomson-Houston multipolar generator, direct coupled, i. e., the armature of the generator is mounted directly on the engine shaft, no belts being used; one 750-HP. tandem Reynolds-Corliss compound engine with a 500-K. W. multipolar direct coupled Thomson-Houston generator; one 750-HP. Hammond-Williams vertical engine, direct coupled to a multipolar 500-K. W. generator; one 400-HP. compound Mackintosh-Seymour tandem engine coupled direct to a multipolar 250-K. W. generator; one 750-HP. tandem compound Green engine belted direct to a multipolar 500-K. W. generator. All the engines will be run condensing. The condensers are located in a pit in the rear of the engines. The top of the pit will be open, and in the bottom two wells will be located about 10 ft. deep, into which water will flow by gravity from the lake. In the bottom of the wells numerous incandescent lamps will be located. From these wells the water will be taken by the air pumps. A 4,000-HP. battery of Babcock & Wilcox boilers will be installed, arranged to burn crude petroleum for fuel. Green economizers of 4,000 HP. will be put in. They consist of series of pipes in the smokestack, through which the feed water circulates before entering the boilers. The heated gases from the boilers pass around these pipes before entering the stack.



Cross Section.



Elevation.

STATION OF THE ELEVATED ELECTRIC RAILWAY; WORLD'S COLUMBIAN EXPOSITION.

A new type of steel steamboat is to be built at the Iowa Iron Works, of Dubuque, Ia., for use on the Mississippi River, to run between St. Louis and the Gulf ports. This vessel is to be made of steel. She would be 230 ft. long, 40 ft. beam and have a freight capacity of 1,000 tons on a draft of 7 ft. of water; and 1,500 tons on 9 ft. draft. The hull will have adjustable keels, or center-boards, 60, 30 and 20 ft. long, respectively. She will have a double set of engines, twin screws and a contract speed of 16 knots per hour. The first boat is to be ready for sea in the spring of 1893. The builders are the Lucias Ship Co., of St. Louis, Mo.

The "Great Colorado Desert" is no longer a desert, says a correspondent of the N. Y. "Tribune." The writer has been examining this region since last February and has explored an area of about 6,450,000 acres, or 160 miles square. He reports a succession of lakes, plenty of water, luxuriant grass and a fertile soil. He says that irrigation will make it the most fertile region in Southern California, and that the Colorado River offers an abundant supply of water with a minimum of work to utilize it. The river lies from 100 to 120 ft. above the sea, and the valley, near Indian Wells, is 35 ft. below the sea. The distance to the river by an air-line is 90 miles, and by existing water courses it is 140 miles, giving a fall of about one foot per mile. The ground falls westward from the river in wide benches of from 5 to 10 ft. each, so that the land could be cheaply irrigated. With the Colorado River at a 16½-ft. stage in September at Fort Yuma, it still furnishes a good supply to the Salton region; and the flood-mark of May and June stands at 20 to 25 ft. So the supply can be relied upon, says the writer. Nearly 10,000 head of cattle are now feeding in the great valley of the Colorado "desert," and there is room for 40,000 more, according to the "Tribune" correspondent.

U. S. Navy Department officials deny that the delivery of armor plates is unsatisfactory to them, and say that the Navy will have all the plates it can find place for within the next six months.

FUEL-GAS VALUES.

By Stephen H. Emmens.

In the report of the Geological Survey of Pennsylvania for 1885, there is an article by Prof. J. P. Lesley, entitled "Some General Considerations of the Pressure, Quantity, Composition and Fuel-Value of Rock-Gas, or the Natural Gas of the Oil Regions of Pennsylvania." In this article reference is made to a report by S. A. Ford, Chief Chemist of the Edgar Thomson Steel Works, who is said to have computed the heat-value of 1,000 cu. ft. of natural gas of average composition as being 210,069,604 calories (gram-degrees C.); and this value is made the basis of many other calculations.

In Vol. I of the "Chemical Technology" now being issued under the editorship of C. E. Groves, F. R. S., and W. Thorp, B. Sc. (Philadelphia, Blakiston, 1889), there is a treatise on "Fuel and Its Applications," by E. J. Mills, D. Sc., F. R. S., and F. J. Rowan, C. E.; and in this treatise (p. 290) the beforementioned report of Mr. S. A. Ford, stated to have been "communicated, through Mr. Carnegie, to the Iron and Steel Institute," is largely quoted without any suggestion that the figures contained in the report are incorrect. And yet the groundwork of Mr. Ford's computation is the assumption that 100 liters = 3.761 cu. ft.!

An equation given to the public by such eminent authorities as Professor Lesley, Dr. Mills and Messrs. Ford, Groves, Thorp, Rowan and Carnegie is, of course, entitled to much respect; but I have had the temerity to test it by some other authorities, and I regret to say that it lacks recognition. Nor is this the only result of my researches. I have found, "horribile dictu," that there exists a lack of unanimity even as regards the metric system itself. Table I. shows how our worthy doctors agree to differ:

Table I.—Some Metric Constants.

Authority.	Cu. ins. in 1 liter.	Cu. ft. in 100 liters.	Liters in 1 cu. ft.
"U. S. Dispensatory," 16th edition	61.0280	3.5311	28.3148
"Art of Electro-Metallurgy," by G. Gore, LL. D., F. R. S.	61.024	3.53148	28.3167
"Service Chemistry," by Prof. Vivian B. Lewes, F. I. C., F. C. S.	61.024	3.53148	28.3167
"The C. G. S. System of Units," by Prof J. D. Everett, F. R. S.	61.022	3.532	28,316
"Civil Engineers' Pocket-Book" (13th ed.), by J. C. Trautwine, C. E.	61.0254*	3.53156	28.3161
Ditto (computed from values given for liters and pints)	61.024425	3.53151	28.3165
"Mechanics' and Engineers' Pocket-Book" (53d ed.), by C. H. Haswell	61.022**	3.5313657	28.317
"Handbook of Chemistry," by Prof. L. Gmelin (Watts' translation)	61.0267	3.5316	28.3156
"Dictionary of Metric Measures," by Latimer Clark, F. R. S.	61.0364	3.5322	28.3110
Ditto	61.04	3.5323	28.3093
Ditto (cube decimeter)	61.0270	3.5316	28.3153
"Wagner's Chemical Technology," by W. Crookes, F. R. S., and Dr. F. Fischer	61.02709	3.53171	28.31529
"Natural Philosophy," by Sir Wm. Thomson, F. R. S., and Prof. P. G. Tait	61.02432	3.5315	28.31606
Mr. S. A. Ford	64.99008	3.761	26.588

* Said to be "U. S. Standard."
** Said to be "by Act of Congress of July 28, 1866;" but at p. 46 Haswell gives 1 liter=61.02524 cu. ins.

A glance at this table and a remembrance of many wondrous stories as to the almost infinitesimal accuracy of modern engineering measurements are calculated to enhance the admiration generally experienced by those who study the goodness and wisdom and simplicity of our nineteenth-century scientists.

Returning to Mr. Ford's paper, I may mention that the quotations given therefrom by Professor Lesley and Messrs. Mills and Rowan contain several arithmetical inaccuracies. For example, Mr. Ford is represented as saying: "Then 57.25 lbs. of carbon contain the same number of heat units as a 1,000 cu. ft. of the natural gas, viz., 210,069,604. Now, if we say that coke contains in round numbers 90% carbon, then we will have 62.97 lbs. of coke equal in heat units to 1,000 cu. ft. of natural gas." Here the quantity 62.97 is obviously arrived at by the addition $57.25 + \frac{57.25}{10}$; whereas the correct quantity is $57.25 + \frac{57.25}{9} = 63.61$.

Considerations of space forbid my entering at further length into the correction of published errors. Every careful man who has ever consulted a textbook will grimly admit the justice of this remark: even though he may willingly agree with me in sincerely thanking the Trautwines and Haswells and Gmelins, and Clarks, and Thomsons, and Favres, and Regnaults and Berthelots, and all the brilliant compilers and experimentists who have done so much good and worthy work in aiding the progress of knowledge.

The particular inaccuracies, however, to which I have here called attention, show that a recomputation of fuel-gas heat values may very possibly be of service to engineers and others; and this must be my excuse for the following calculations.

I do not know whether it is congenital sin, acquired depravity or sheer eccentricity that causes me to smile when I hear my scientific brethren speak of "constants." Anything more inconstant than a constant is not to be imagined. See the text-books everywhere. Hence I deem it an almost solemn duty on the part of everyone who publishes the results of computation or experiment to set forth the particular constants he has employed; and in accordance with this view I present Tables II, III and IV.

Table II.—Constants for Specific Gravities and Heats.

Substance.	Weight of 1 liter in grams at 0° C. and 760 mm.	Specific heat at constant		
		Logarithms.	pressure.	Logarithms.
Atmospheric air	1.293	.11160	.2374	−1.37548
Nitrogen	1.2550	.09864	.244	−1.38739
Oxygen	1.429	.15503	.2175	−1.33746
Water vapor	.8042	−1.90536	.48	−1.68124
Hydrogen	.08961	−2.95236	3.41	.53275
Marsh gas	.7238	−1.85962	.593	−1.77305
Olefiant gas	1.2550	.09864	.404	−1.60638
Ethane	1.3446	.12859	.....	.....
Carbonic oxide	1.250	.09691	.245	−1.38917
Carbonic acid	1.976	.29579	.215	−1.33244
Sulphurous anhydride	2.905	.46315	.154	−1.18752

Table III.—Constants for Heats of Combustion.

Reaction.	Per gram of	Heat produced. Calories.	Logarithms.
$H_2 + O = 2$—the product being liquid water	H	34,000	4.53148
$H_2 + O = 2$—the product being gaseous water	H	28,951	4.46166
$C + 2O$—the carbon being solid	C	8,080	3.90741
$C + 2O$—the carbon being liquid or gaseous	C	11,214	4.04976
$C + O$—the carbon being solid	C	2,416	3.38310
$CO + O$	C	5,664	3.75312
$CO + O$	CO	2,427	3.38507
$CH_4 + 4O$	CH_4	13,062	4.11601
$C_2H_4 + 6O$	C_2H_4	11,857	4.07398
$C_2H_5 + 7O$	C_2H_6	11,559	4.06292
$S + O_2$	S	2,221	3.34655

Table IV.—Various Constants.

Description.	Number.	Logarithm.
Number of grains in 1 gram	15.43235	1.18843
Number of grams in 1 lb. avoirdupois	453.5926	2.65667
Number of liters in 1 cu. ft.	28.3127	1.45198
Number of cu. ft. in 100 liters	3.532	.54802
Number of calories (gram-degree C.) in 1 British thermal unit (lb.-deg.-Fahr.)	251.996	2.40139
Number of British thermal units in 1 calorie	.003968	−3.59861
Ratio of nitrogen to oxygen (by weight) in atmospheric air (77:23)	3.34783	.52477
Gaseous volume at 62° F. The Volume at 0° C. being unity	1.00050	.02551

In addition to a suitable selection of constants it is convenient to have some standard fuel for the purpose of comparison. Solid carbon is usually referred to; but as it is not an actual article in commercial industry, secondary comparisons are generally instituted with the heat values of coal and coke. Let us investigate these values a little:

Carbon.—One hundred grams produce a total heat value of 808,000 calories. But the quantity of oxygen required for combustion is 266⅔ grams and this (if derived from the atmosphere) is accompanied by 892.7 grams of nitrogen. The chimney gases will, consequently consist of 366⅔ grams of carbon dioxide and 892.7 grams of nitrogen. If these gases be allowed to escape at a temperature 300° C. in excess of that of the atmosphere, they will carry away 118,146 calories, and the heat value of the 100 grams of carbon which is actually available is thus seen to be only 689,854 calories. The corresponding values for 1 lb. of carbon are:

Total calories, 3,665,080; available calories, 3,129,166. To these may usefully be added the following figures: Cubic feet of air required for the combustion of 1 lb. of carbon, 143.67; available calories per cubic foot of air, 21,781.

Anthracite.—Bloxam ("Chemistry," 6th ed., p. 74), gives the following as the composition of anthracite:

Carbon.	Hydrogen.	Nitrogen.	Oxygen.	Sulphur.	Ash.
90.39	3.28	0.83	2.98	0.91	1.61

This corresponds to a total heat value of 3,703,910 calories per lb.

Bituminous Coal.—In the before-mentioned paper by Mr. Ford the following is given as the composition of a bituminous coal "slightly above the general average of the Pittsburg coal":

Carbon.	Hydrogen.	Nitrogen.	Oxygen.	Sulphur.	Ash.
82.75	5.31	1.04	4.64	.95	5.31

This corresponds to the following:

Total calories per lb.	3,663,250
Available " " "	3,253,966
Cubic feet of air required per lb.	139.79
Available calories per cu. ft. of air	23.277

Coke.—At p. 143 of the before mentioned "Chemical Technology" is a table giving 19 analyses of American coke. They run as follows:

Carbon	84.82% to 97.60%
Ash	1.55% " 14.40%
Sulphur	0.69% " 2.08%

The average heat-value of coke may, therefore, as Mr. Ford suggests, be taken as 90% of that of carbon, or, say, a total of 3,208,572 calories per lb.

It will be seen from the foregoing that no marked distinction exists between the respective heat-values of carbon, bituminous coal and anthracite, and that accordingly bituminous coal may be adopted as the standard fuel for purposes of comparison.

Coming now to gaseous fuels we find the following list to comprise all the practical fuel-gases hitherto introduced:

1. Hydrogen.

2. Water Gas.—The typical form of this is the product that results from the action of steam on red-hot coke. An analysis given in Dr. Percy's "Metallurgy," vol. Fuel, p. 418, is as follows:

	By volume.	By weight grams per 100 liters.
Hydrogen, H	54.52%	4.886
Marsh gas, CH_4	1.62%	1.173
Carbonic oxide, CO	31.86%	39.825
" acid, CO_2	12.00%	23.712
	100.00%	69.596

3. Siemens Gas.—By this, I mean fuel gas produced by the passage of atmospheric air through ignited coal in quantity sufficient to form carbonic oxide. The chemical composition of the product thus obtained, as computed from the average of five analyses of Siemens producer gas (Vide Vol. XI., p. 300, "Trans. Am. Inst. Mining Engineers"), is as follows:

H	0.932	grams per 100 liters.
CH_4	1.346	" "
CO	27.425	" "
CO_2	10.915	" "
N	75.330	" "
	115.978	" "

4. Mixed Producer Gas.—This is the type generally employed and is manufactured by passing air and steam through ignited coal. Many forms of apparatus and methods of working have been invented; and the varieties of gas produced are fairly represented by the following analyses of "Strong" and "Wilson" gases.

That for the "Strong" gas is computed from an analysis of the dry gas, after having been washed, made by Dr. G. E. Moore, of Jersey City, for the American Gas Fuel and Light Co., of New York. The figures for the "Wilson" gas are an average of three analyses appearing on p. 282 of the before mentioned "Chemical Technology."

	Grams per 100 liters. "Strong" gas.	"Wilson" gas.
H	4.728	1.071
CO_2	4.051	9.188
CO	44.850	30.800
CH_4	2.975	1.629
N	5.560	70.920
O	1.100	.....
	63.264	113.608

5. Natural Gas.—The average composition of this, by volume, is given by Mr. S. A. Ford as follows. I have added the equivalent weight values:

	By volume. %	By weight. grams per 100 liters.
Hydrogen, H	22.00	1.9741
Marsh gas, CH_4	67.00	48.4944
Olefiant, " C_2H_4	1.00	1.2550
Ethylic Hydride, C_2H_6	5.00	6.7230
Carbonic Oxide, CO	0.00	.7500
" Acid, CO_2	0.00	1.1856
Nitrogen, N	3.00	3.7650
Oxygen, O	.00	1.1422
	100.00	65.290

Mr. Ford gives a total weight of 64.8585 grams per 100 liters owing, probably, to his adoption of slightly different "constants."

6. Coal Gas.—Ordinary illuminating gas is frequently used for heating purposes. Its average composition may be taken as follows:

	By volume. %	By weight, grams per 100 liters.
Hydrogen, H	46.60	4.1221
Marsh gas, CH_4	40.00	28.9520
Olefiant " , C_2H_4	4.00	5.0200
Carbonic oxide, CO	6.00	7.5000
" acid, CO_2	.50	.9880
Nitrogen, N	1.50	1.8825
Oxygen, O	.50	.7145
Water vapor, H_2O	1.50	1.2063
	100.00	50.3854

The foregoing figures are summarized in Table V., which also shows the weight per 1,000 cu. ft. in lbs. avoirdupois and the percentage of combustible matter.

Table V.—Weight and Composition of Gaseous Fuel.

Fuel.	H.	CO.	CH_4.	Grams in 100 liters. C_2H_4.	C_2H_2.	CO_2.	N.	O.	H_2O	Total.	Lbs. av. in 1,000 cu. ft.	Percentage of combustible matter.
Hydrogen	8.961	.....	.....	.....	.....	.....	.....	.....	.....	8.961	5.593	100.00
Natural gas	1.9741	.75	48.4944	1.255	6.723	1.1856	3.765	1.1432	65.2903	40.753	90.67
Coal gas	4.1221	7.500	28.952	5.020	1.2063	0.988	1.8825	0.7145	50.3854	31.488	90.49
									(H_2O)			
Siemens producer gas	.932	27.425	1.346	.....	.....	10.945	75.330	.....	115.978	72.390	25.61
Water gas	4.886	39.825	1.173	.....	.....	23.712	.....	.....	69.596	43.441	95.91
Strong producer gas	4.728	44.850	2.975	.....	.....	4.051	5.560	1.100	63.264	39.488	85.07
Wilson producer gas	1.071	30.800	1.629	.....	.....	9.188	70.920	.....	113.608	70.913	29.40

The total heat-values of the various gases are shown in Table VI., together with the equivalents of 1,000 cu. ft. in pounds of coal and crude petroleum respectively—the latter being computed on the basis of the gravity and composition attributed by M. Goulishambaroff (Compt. Rend. tome LXIX., pp. 442-453) to "Pennsylvania Crude Heavy Petroleum Oil," viz.:

Carbon	84.9
Hydrogen	13.7
Oxygen	1.4
	100.0
Sp. Gr.	0.886

The same being equivalent to:

Total heat value, 6,094,710 calories per lb. or 44,935,600 calories per gallon.

Available heat value, 5,550,747 calories per lb., or 40,924,000 calories per gallon.

Table VI.—Total Heat-Values of Gaseous Fuel.

Fuel.	Calories per 100 liters.	Calories per 1,000 cu. ft.	British thermal units per 1,000 cu. ft.	Equivalent of 1,000 cu. ft. in lbs. of coal.	Equivalent of 1,000 cu. ft. in lbs. of crude petroleum.	Equivalent of 1,000 cu. ft. in gallons of crude petroleum.
Hydrogen	259,431	73,451,700	291,480	20.05	12.05	1.634
Natural gas	780,855	221,079,000	877,300	60.35	36.27	4.951
Coal gas	575,237	162,867,000	646,314	44.46	26.72	3.62
Siemens gas	111,128	31,462,100	124,853	8.57	5.16	.696
Water gas	253,423	71,751,170	284,733	19.59	11.77	1.597
Strong gas	280,607	79,446,700	315,271	21.69	13.04	1.768
Wilson gas	127,026	35,964,200	142,720	9.82	5.90	.800

By way of final comparison between hydrogen, natural gas, coal gas and Siemens producer gas, Tables VII. and VIII., of combustion data and available heat values are given.

Table VII.—Combustion Data for Gaseous Fuel.

Fuel.	Grams of oxygen required for the combustion of 100 liters.	Cu. ft. of air at 62° F. required for the combustion of 1,000 cu. ft.	Grams of products from combustion of 100 liters. Water	Carbon dioxide.	Nitrogen.	Calories in chimney gases from 1,000 cu. ft. at 300° C., over atmospheric temperature.
Hydrogen	71.688	2556.	80.649	.....	240.000	8,262,000
Natural gas	238.458	8503.	140.594	159.389	892.071	25,265,909
Coal gas	109.565	6081.71	100.899	117.0907	559.559	15,856,500
Siemens producer gas	28.511	1017.	11.417	57.743	170.782	5,058,200

Table VIII.—Available Heat-Values of Gaseous Fuel.

Fuel.	Per 1,000 cu. ft. Calories.	Per 1,000 cu. ft. British thermal units.	Per cu. ft. of combined fuel and air needed for combustion. Calories.	Equivalent of 1,000 cu. ft. in British thermal units.	Equivalent of 1,000 cu. ft. in lbs. of coal.	Equivalent of 1,000 cu. ft. in lbs. of crude petroleum.	Equivalent of 1,000 cu. ft. in gallons of crude petroleum.
Hydrogen	65,189,700	258,688	18,332	72.75	20.03	11.74	1.592
Natural gas	195,813,000	777,050	20,005	81.77	60.18	35.28	4.785
Coal gas	146,980,500	583,271	20,755	82.36	45.17	26.48	3.591
Siemens' gas	26,403,840	104,778	13,090	51.95	8.11	4.76	.645

It must be remembered that the weights, compositions and heat-values of the several gases are given for a temperature of 0°C. and a barometric pressure of 760 mm. For gases at the ordinary temperature the figures must be reduced by about 7%.

An elevated electric railway is proposed at Tacoma, Wash. A full size experimental loop line, 800 to 1,000 ft. in length, is to be built by the inventor, L. F. Cook.

THE LAUTERBRUNNEN-MUERREN CABLE INCLINE RAILWAY, SWITZERLAND.

We are indebted to an article in a recent issue of the "Schweizerische Bauzeitung" for the accompanying illustrations of the combined cable incline and electric railway, completed about a year ago between Lauterbrunnen, a village of the Canton Berne, Switzerland, and Muerren, a picturesque resort in the neighboring highlands. The total length of the road is 18,666 ft., or somewhat over 3½ miles, of which distance 4,566 ft. from Lauterbrunnen to Gruetsch is operated by cable, and 14,100 ft. from Gruetsch to Muerren by the electric trolley system. This last portion of the line presents little of especial interest beyond ordinary trolley systems. The current for its operation is generated at Gruetsch, the dynamo being actuated by a 120-HP. turbine. The total elevation overcome is 495 ft., with a maximum grade of 5%.

The portion of the line of most interest is the incline operated by cable. This incline begins at Lauterbrunnen and runs in a straight line to the summit of the Gruetsch-Alp, its total length along the rail being 4,566 ft. and the total rise 2,211 ft. The line begins with a vertical curve of 7,546-ft. radius tangent to a grade of 42½%, which soon increases to a grade of 50% and then decreased to a grade of 49.2%. At a point 1,470 ft. from the bottom the grade increases to 60%, which continues to the summit, the change being affected by a vertical curve with a 5,905-ft. radius.

The road is of the three rail type with a turnout 410 ft. long near the center of the line, the middle rail being used in common by both ascending and descending cars, with the exception of about 130 ft. at the upper end where a fourth rail is introduced to avoid the use of lateral guiding sheaves for the cable. The track is laid on longitudinal timbers bolted to the concrete foundations as shown in Fig. 1. It consists of three traction rails of the Vignoles pattern laid at metre gage and of two Riggenbach safety racks, 5½ ins. high, 9 11-16 ins. wide and 3 15-16 ins. pitch, weighing 96.8 lbs. per yard, laid on steel ties of the inverted trough pattern with sloping sides and wide flanges similar to those used on solid floor railway bridges in Switzerland (Eng. News, March 26, 1892).

The lengths of the viaducts on the line aggregate about one-fourth its entire length. The principal of these, shown in half section and half elevation in Fig. 2, is of masonry and is 721 ft. long.

Water ballast is used as a motive power, and the conditions imposed by the profile adopted were such that, in order to secure satisfactory opration, a gradual emptying of the water ballast tanks had to be provided. These tanks are placed underneath the cars and have an approximate capacity of 1,800 gallons each. They drain into ditches located on each side of the track, as shown in Figs. 3 and 4. Fig. 3 shows the character of the construction in loose earth which necessitates the use of retaining

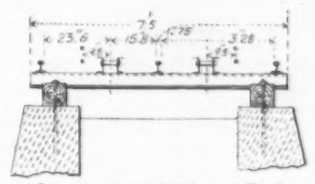


Fig. 1 Cross Section of Track.

walls, and Fig. 4 that in solid rock or firm soil. The foundations and retaining walls are of concrete and the drains are lined with beton.

The cars have a capacity of 40 passengers. They are provided with hand and automatic brakes; the latter being designed to work when the cable breaks or the rate of speed of the car exceeds 4½ ft. per second. They are also under control of the conductor.

Fig. 2. Elevation and Longitudinal Section of Viaduct.

The cable was manufactured by Felton & Guilleaume and is what is known as a compound cable. It is constructed of crucible steel wires of different gages, the aim being to equalize as far as possible the strain on the several wires. It passes around a 12-ft. drum at the summit station and is supported along the line by idlers placed from 42 ft. to 52 ft. apart.

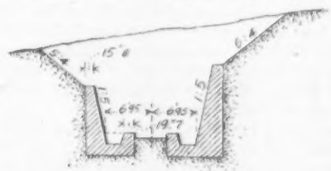


Fig. 3. Cross Section of Cut in Loose Earth

The water for ballast is secured from a masonry reservoir of 26,420 gallons capacity, which is supplied by springs through a supply main 4,600 ft. long. The supply of water to the reservoir is regulated by a float operating a cut-off valve.

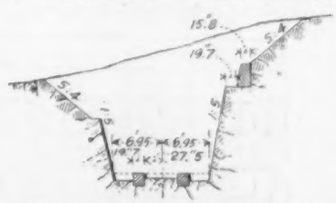


Fig. 4. Cross Section in Rock Cut.

The franchise for this line was granted in 1887 and the work of construction was carried out by Messrs. Frey & Haag. The owners of the line are the Lauterbrunnen-Muerren Mountain Ry. Co.

The District Commissioners of Washington, D. C., estimate that it will require $26,765,905 to properly conduct the affairs of the district during the fiscal year ending June 30, 1894. The engineering departments demand the following sums in chief: Permit work, $190,000; improvement and repairs of streets, $800,500; sewers and repairs, $508,312; lighting, gas and electric, $225,665; bridges, $25,000.

RAINFALL, FLOW OF STREAMS AND STORAGE.

In no other part of his work, perhaps, is the water-works engineer so hampered by lack of data as in that pertaining to the yield of water which may be expected from a given drainage area. The most complete studies of this subject in this country have been made in connection with the drainage areas of the New York and Boston water-works, and the latest facts in connection with the Boston works were set forth in a very able way by Mr. Desmond Fitz Gerald, M. Am. Soc. C. E., in a paper on "Rainfall, Flow of Streams and Storage," read before the American Society of Civil Engineers at Fortress Monroe, June, 1892. This paper was accompanied by 16 tables showing in detail the monthly rainfall at Boston for the past 74 years; the monthly rainfall on the Sudbury River water shed for the past 16 years; the rainfall collected expressed in various ways; the evaporation from the same watershed, and other similar information.

The paper was accompanied by diagrams, most of which we give herewith, together with an abstract of the paper itself. Those interested in the detailed figures are referred to the paper, which will be published in due time by the American Society of Civil Engineers. The tables upon which the paper is based were prepared in the summer of 1891 to aid in calculating the yield of drainage areas in Massachusetts with varying proportions of land and water. The yearly mean of rainfall at Boston for 74 years is 47 ins.; on the Cochituate watershed, 47.98 ins.; on the Sudbury watershed, 45.8 ins. The Providence and Lowell records give a yearly average of about 45 ins. Mr. Fitz Gerald assumes that a general average for Boston is 48 ins.

The largest annual rainfall at Boston in the last 74 years was 67.72 ins. in 1863, and the smallest 27.2 ins. in 1822. The maximum monthly rainfall in the period was 12.38 ins. in July, 1863, and the minimum was 0.23 ins. in September, 1884. During the period the rainfall exceeded 10 ins. in 13 different months, but only once, strange to say, since 1873.

The fluctuations in the monthly means are shown graphically in Fig. 1, the lines showing the mean for each month for the entire period of years above stated.

That the rainfall is distributed throughout the year with surprising evenness is shown by the following figures giving the average rainfall for each season:

	Boston.	Cochituate.	Sudbury.
Spring	12.21	12.09	11.10
Summer	11.37	12.49	11.00
Autumn	11.70	12.31	11.75
Winter	11.72	11.09	11.95

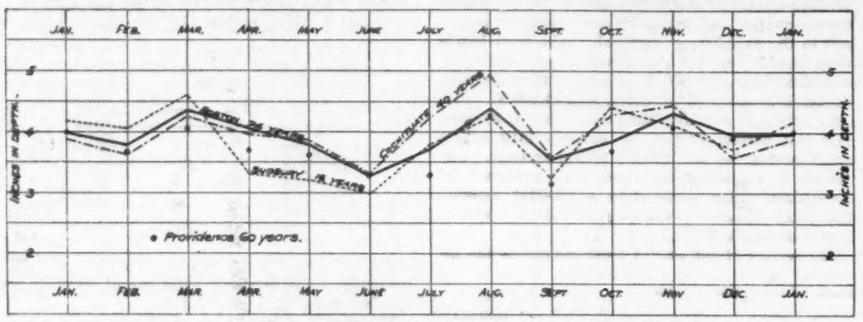


FIG. 1. MEAN MONTHLY RAINFALL OF BOSTON AND VICINITY.

The same evenness of distribution does not hold in respect to the yield from drainage areas, by any means, as below shown.

Having settled what rainfall may be expected in a given locality and how it is likely to be distributed during the year, the next problem is to determine how much of the total rainfall may be made available, provided proper storage facilities are provided.

The average of a number of years shows that from 45 to 50% of the rainfall flows into the stream from the surface of the ground. The evaporation from a water surface is greater than from the ground.

Although the rainfall may be quite evenly distributed throughout the year on the average, excessive evaporation in summer and frozen ground, snow and ice in winter all tend to make the flow of a stream irregular. The diagram, Fig. 3, shows at a glance the mean monthly yields of the Sudbury, Cochituate and Mystic watersheds, in millions of gallons per square mile, for the 13 years 1878 to 1890. The heavy line on the diagram is a mean of the three, the values of which are given below in gallons and cubic feet per second as the yield per square mile of a typical New England watershed:

	Gallons.	Cu. ft. per second.
January	37,387,000	1.868
February	55,056,000	3.042
March	71,226,000	3.555
April	49,107,000	2.533
May	30,406,000	1.518
June	14,975,000	0.772
July	7,491,000	0.374
August	11,399,000	0.569
September	10,242,000	0.528
October	16,797,000	0.838
November	24,787,000	1.278
December	34,128,000	1.703
Total and mean	363,001,000	1.539

Fig. 4 presents the above monthly results in order of their magnitude, the months in order of dryness averaging as follows:

1. July.	4. June.	7. May.	10. April
2. September.	5. October.	8. December.	11. February.
3. August.	6. November.	9. January.	12. March.

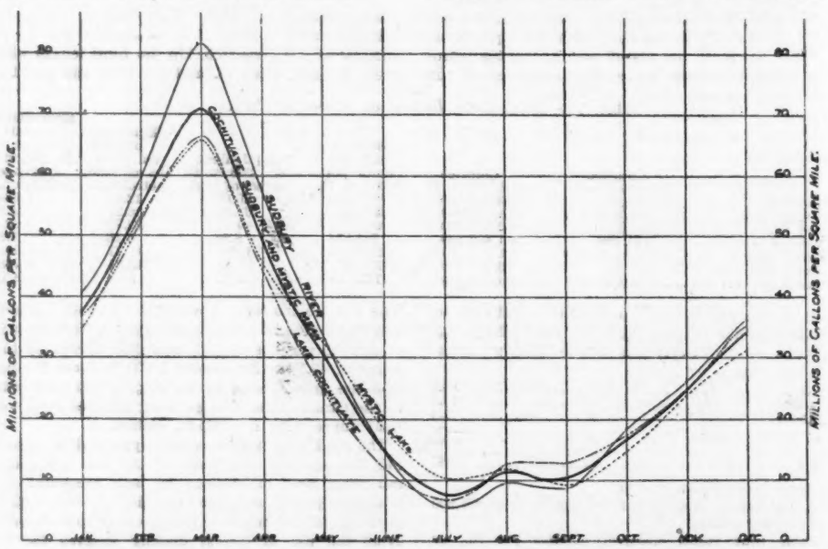


FIG. 3. MEAN MONTHLY YIELDS OF SUDBURY, COCHITUATE AND MYSTIC WATERSHEDS IN MILLIONS OF U. S. GALLONS PER SQUARE MILE FOR 13 YEARS, 1878 TO 1890.

Fig. 2 is a mean monthly evaporation curve showing the evaporation from a water surface. The data, since somewhat extended, upon which this curve is based were given in an elaborate paper by Mr. Fitz Gerald on "Evaporation" (Trans. Am. Soc. C. E., vol. xv., p. 581). The mean evaporation from a water surface in Boston is 39.2 ins., or about 82% of the mean rainfall, but it must not be thought that there is a direct connection between rainfall and evaporation from a water surface.

The four wettest months are, therefore, the first four of the year, supplying 212,776,000 gallons per square mile, against only 44,107,000 in the four summer months, June, July, August and September; the mean yield per month of the year being 30,250,000 gallons.

The Sudbury watershed alone had an average yield for 16 years of 1.669 cu. ft. per second, corresponding closely with the Croton watershed mean of 1.626. May represents the mean monthly flow of the year.

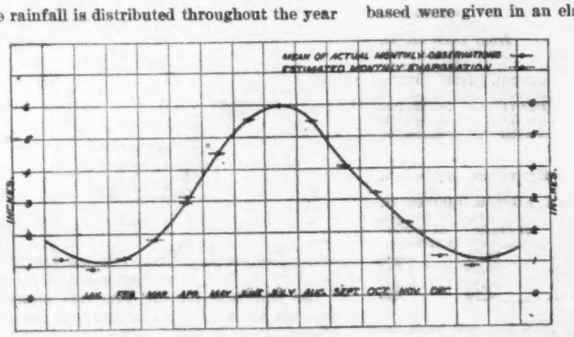

MEAN OF ACTUAL MONTHLY OBSERVATIONS
ESTIMATED MONTHLY EVAPORATION
INCHES.
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.

FIG. 2. MEAN MONTHLY EVAPORATION.

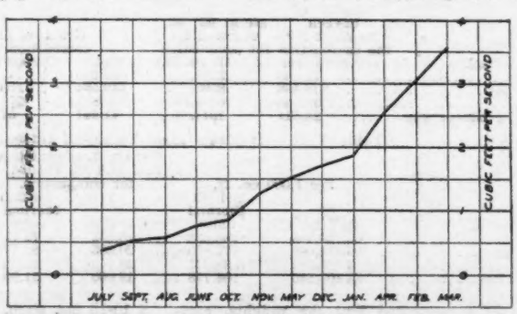


FIG. 4. AVERAGE YIELD PER SQUARE MILE OF COCHITUATE, SUDBURY AND MYSTIC WATERSHEDS, 1878-1890 INCLUSIVE; MONTHS ARRANGED IN ORDER OF AMOUNT OF YIELD.

The "ordinary" flow of a stream is obtained by Mr. Fitz Gerald by taking the months above the average at their average rate for past years and adding to these the five months of mean flow, all as given above, excluding July as having an insignificant flow. This gives a flow of 706,600 gallons per day, or about 1.1 cu. ft. per second per square mile.

Regarding freshets, Mr. Fitz Gerald may be quoted as follows:

The greatest freshet occurring on the Sudbury watershed took place Feb. 10-13, 1886, and a full description of its effects can be found in the "Transactions" of the American Society of Civil Engineers, for September, 1891.* The maximum yield for 24 hours was equal to 1.54 ins. in depth upon the surface, or 26,763,260 gallons per square mile, or 41.4 cu. ft. per second per square mile, and the maximum rate of yield was equal to 1.646 ins. in depth on the watershed in 24 hours, or 44.2 cu. ft. per second per square mile. On March 26, 1876, a freshet giving nearly the same yield occurred, so that it is not probable that this amount of rainfall collected in 24 hours is very unusual.

*See Eng. News, Apr. 3, 1886, for brief account of this rainfall.

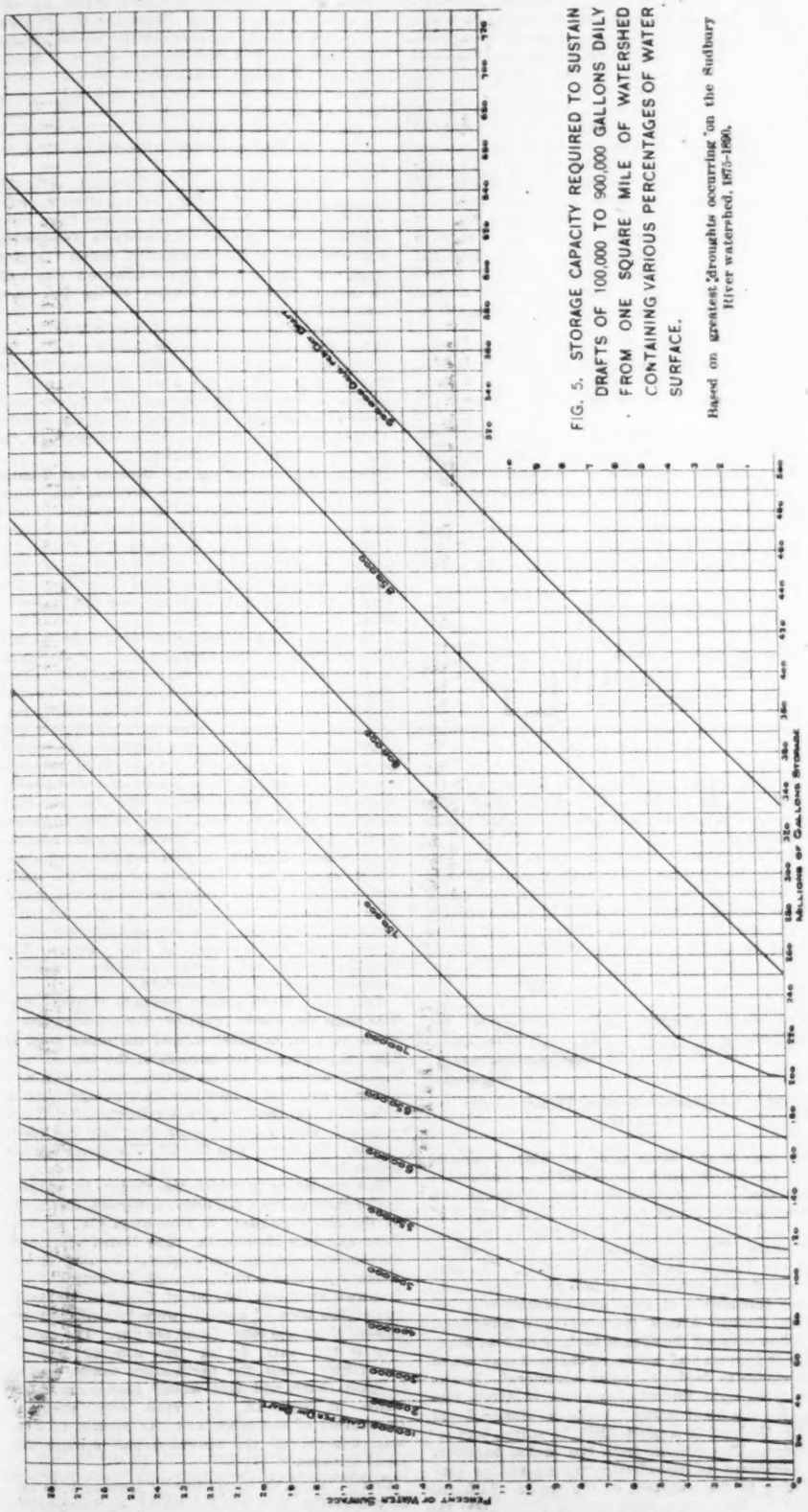


FIG. 5. STORAGE CAPACITY REQUIRED TO SUSTAIN DRAFTS OF 100,000 TO 900,000 GALLONS DAILY FROM ONE SQUARE MILE OF WATERSHED CONTAINING VARIOUS PERCENTAGES OF WATER SURFACE.

Based on greatest droughts occurring on the Sudbury River watershed, 1875-1890.

Gagings on a small affluent of the Sudbury, embracing 6.434 square miles of surface, showed a similar flow per square mile to that in the main stream. The maximum rate for 24 hours in the small affluent was equal to 1.801 ins. of depth on its drainage area. Although these freshets were considered very disastrous in Massachusetts, they cannot be considered large when compared with what has been observed in neighboring watersheds. Freshets of 3 and 4 ins., collected in 24 hours, are within the experience of many hydraulic engineers, and it certainly would not be safe in designing dams to provide for less than 6 ins. collected in 24 hours, and flowing continuously, or 104,272,440 gallons per square mile per 24 hours, or 161.3 cu. ft. per second. These remarks are, of course, applicable only to an ordinary New England watershed not covered with houses and streets. The water-works engineer who is constantly designing waste weirs, dams, reservoirs, etc., may find it convenient to bear in mind that one square mile of land surface yields approximately 1.5 cu. ft. per second throughout the year, and that the maximum freshet flow may be 100 times this amount, or 150 cu. ft. per second. In millions of gallons this becomes 1,000,000 and 100,000,000 respectively.

The largest monthly flow during the past 16 years in the Sudbury River watershed was 149,220,000 gallons per square mile, or 7.448 cu. ft. per second per square mile, which was more than 100 times the minimum monthly yield. This occurred in March, 1877, which is the month of maximum yield for the period.

The minimum yield of the Sudbury watershed in 16 years was in September, 1884, only 1,318,000 gallons per square mile for the month, or 0.068 cu. ft. per second per square mile. The water surface of the area during this month was 0.0303 of the total area.

The average daily yield of one mile of average watershed is given as 1,000,000 gallons, or 1.547 cu. ft. per second.

The mean percentages of rainfall collected in the Sudbury watershed for the 16 years 1875-90, and in the Cochituate for the 29 years, 1863-91, are as follows:

	Sudbury, 1875-90.	Cochituate, 1863-91.
January	49.1	53.1
February	78.2	71.9
March	109.6	84.6
April	109.1	83.8
May	62.3	47.9
June	29.1	27.9
July	8.9	13.1
August	13.0	17.7
September	14.2	23.5
October	23.1	23.6
November	39.5	34.0
December	52.5	49.9
Mean.	49.5	43.8

Accumulations of rainfall, generally in the form of snow, passing off finally in a different month from that in which it fell, give rise to the percentages over 100.

Fig. 5 is a diagram showing the storage capacity required to sustain daily drafts of 100,000 to 900,000 gallons from one square mile of watershed when the watershed has varying percentages of water surface. The diagram is based on the greatest drafts on the Sudbury River from 1875 to 1890, inclusive.

In connection with storage Mr. Fitz Gerald may be quoted as follows:

When storage reservoirs are distributed on different portions of a watershed, it is important to consider them with reference to their positions, the extent of their individual drainage areas, and their capacities for yield in connection with other portions of the watershed; and these studies afford some of the most interesting problems for the water-works expert. It is believed that the data collected in this paper will give the means for solving these problems.

In a valuable report by Mr. Frederic P. Stearns, M. Am. Soc. C. E., to the Massachusetts State Board of Health, on "The Selection of Sources of Water Supply," (see Eng. News, Nov. 7, 1891), the author has given a series of diagrams illustrating the fluctuations of a reservoir caused by different daily drafts. These diagrams show that, no matter what the extent of the storage may be, the effect of drafts beyond, say 600,000 gallons daily per square mile, is to keep a storage reservoir below high water for several years.

The importance of this warning cannot be too strongly impressed upon the engineer who is designing systems of storage. The following table, calculated for 0, 10 and 20% water surfaces, shows the length of time that a

reservoir would be below high water during the 16 years we are considering, and under various drafts:

Daily draft Per sq. mile, galls.	—Percentage of water on shed.— 0 per cent.	10 per cent.	20 per cent.
100,000.....	1½ mos.	6½ mos.	7½ mos.
150,000.....	3½ "	7½ "	8½ "
200,000.....	7½ "	7½ "	8½ "
250,000.....	7½ "	8½ "	8½ "
300,000.....	8½ "	8½ "	8½ "
350,000.....	9½ "	9½ "	9½ "
400,000.....	9½ "	10½ "	10½ "
450,000.....	9½ "	10½ "	1 yr. 9½ "
500,000.....	9½ "	10½ "	1 " 9½ "
550,000.....	9½ " 1 yr.	9½ "	1 " 10½ "
600,000.....	10½ " 1 "	9½ "	1 " 10½ "
650,000.....	10½ " 1 "	9½ "	7 " 8½ "
700,000..... 1 yr.	9½ " 1 "	10½ "	8 " 10½ "
750,000..... 1 "	9½ " 1 "	11½ "	9 " 7½ "
800,000..... 4 "	10½ " 7 "	8½ "	10 " 5½ "
850,000..... 6 "	8½ " 8 "	11½ "	11 " 9½ "
900,000..... 7 "	9½ " 9 "	8½ "	Probably about 13 yrs., 9 mos.

As it is undesirable to keep the water below high water for more than two years in succession, it will be seen that, no matter what the extent of the storage may be, it is impracticable to secure more than about 750,000 gallons daily from 1 sq. mile of watershed, containing 10% water surface. As there are circumstances which permit of a different method of managing a storage basin and where the bad influences of keeping a reservoir low for several years are immaterial, the table for storage is carried to 900,000 gallons daily draft. With this draft a basin on the Sudbury River watershed would have been 106½ months, or nearly nine years, without filling to its high water line during the period 1875-90, and a heavy growth of vegetation would undoubtedly have sprung up on the exposed margins during this long interval.

To secure this draft a storage of 377,800,000 gallons per square mile becomes necessary, which, if provided, would change the percentage of water surface from 2½ to 12%, reckoning depths usually found, and requiring an increase of another 100,000,000 gallons to the storage, which in turn requires another correction for increase of water surface.

The writer has had an opportunity to apply the calculated yields from various percentages of land and water surface to three water-sheds, one with no water surface, another with 5% of water surface, and the third with 10% of water surface. Daily gagings of flow were mode for 16 months, with the results shown in the following table:

Three Watersheds with Varying Percentages of Water Surface.—Ratios of Calculated Yields to Weir Measurements.

	0 per cent.	5 per cent.	10 per cent.
1890.—February	0.957	0.934	0.958
March	0.925	1.031	1.005
April	1.056	0.965	0.864
May	0.945	0.865	0.859
June	1.297	1.029	0.934
July	13.391	0.713	1.742
August	4.320	0.548	—0.277
September	1.041	0.885	1.045
October	0.850	1.110	1.164
November	1.201	1.343	0.982
December	0.950	0.909	0.908
1891.—January	1.034	0.983	1.010
February	1.070	1.009	0.996
March	1.012	1.141	1.028
April	1.060	1.095	1.018
May	1.024	0.821	0.578
Mean.	1.014	1.023	0.977

With the exception of 0%, these ratios are thought to be satisfactory as showing the general accuracy of the data on which the yields for different percentages of water surface are based. A large swamp upon the water-shed, with no water surface, probably caused the failure in the case of the 0%, which, however, is somewhat magnified in the table by the fact that the yield was small, though the ratios are large. The writer is inclined to caution engineers against the use of the table for 0% of water surface on account of the difficulty of finding areas of any great extent free from ponds, swamps or marshes. It is doubtful if it is advisable to use anything under 2%.

Since the above was in type we have received from Mr. Fitz Gerald the following statement of the water collected on the Sudbury River watershed during the 12 months ending June 1, 1892:

Monthly flow in inches on the watershed of the Sudbury River, 75.2 sq. miles, June 1, 1891, to June 1, 1892.

June	0.71
July	0.27
August	0.29
September	0.35
October	0.37
November	0.53
December	0.97
January	3.34
February	1.57
March	3.49
April	1.50
May	2.24
Total	15.63

SEWAGE PURIFICATION IN AMERICA.

(Continued from page 341.)

Coney Island, N. Y.

The sewage purification plant at Coney Island was first operated during the summer of 1887. At this plant the same process is used as at White Plains, Sheepshead Bay and Round Lake (Eng. News, Sept. 22 and 29, Oct. 6 and 13, 1892), but the details are simple, as the works at Coney Island were built first.

The extremely unsanitary condition of Coney Island in and prior to 1885 was reviewed at length by Mr. W. P. Gerhard, C. E., in Engineering News of Sept. 19 and Oct. 3, 1885. The condition there described must have grown worse until 1887, but since the sewerage system was constructed the sanitary improvement of the village has been great, especially since the erection of a garbage crematory in November, 1888. At present the sludge from the chemical precipitation plant is also burned in the crematory, rendering Coney Island unique among American cities in the disposal of its wastes.

For a full understanding of the unsanitary condition of Coney Island prior to the introduction of sewers the reader is referred to the two articles mentioned just above, which may be summarized as follows:

For many years the large summer hotels discharged their sewage into the surrounding salt water and the occupants of cottages and other small buildings used privies built over holes in the sand. These privies were sometimes moved and the pit filled with sand. Slops and kitchen waste were thrown or discharged on top of the ground. Gradually the beaches, bays and creeks

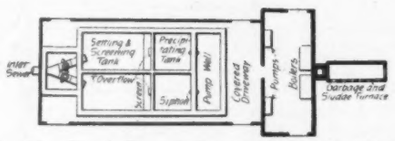


Fig. 35. Sketch Plan of Sewage Purification Works at Coney Island, N. Y.

became fouled with sewage. The fine sand of the island was not capable of rendering inoffensive the wastes it received and finally intolerable nuisances arose.

The large hotels were, naturally, first in attempting to improve theis sanitary surroundings. Mr. J. J. Powers, C. E., of Brooklyn, the owner of the patents already described in these articles, states that as early as 1880 he put in a simple precipitating plant for the Brighton Beach

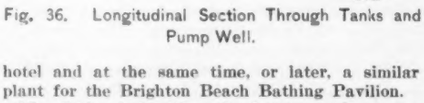


Fig. 36. Longitudinal Section Through Tanks and Pump Well.

hotel and at the same time, or later, a similar plant for the Brighton Beach Bathing Pavilion.

Mr. Gerhard describes the hotel works as two covered wooden tanks, each about 25 ft. long, 7 ft. wide and 3 ft. deep. Each tank was in two compartments. The first compartment had a screen and was designed to retain large solids. The sewage overflowed through a T into the second tank, where perchloride of iron was automatically admitted through a cock operated by a lever-float. A siphon emptied the second tank as soon as filled. Lime or gypsum and powdered charcoal was mixed with sludge to deodorize it before removal. It was then piled upon the meadows and at times was used for the hotel lawns. A pile of sludge found by Mr. Gerhard in August, 1885, he states, was inoffensive. The effluent from the tanks, however, he considered as imperfectly treated and as contributing to the pollution of the water which received it. The tanks were located about 1,000 ft. from the hotel and the effluent was discharged through a long pipe into Coney Island Creek.

The Manhattan Beach and Oriental Hotels and other buildings on Manhattan Beach belonging to the Manhattan Beach Improvement Co., had, in 1885, a joint sewer outfall discharging into a cove of Sheepshead Bay after mechanical separation of some of the solids. This separation was effected by passing the sewage through two long wooden boxes, for alternate use, near the end of which were two wire screens, the first having 1¼ and the second ½-in. meshes. From the end of these boxes the partially clarified sewage passed through a T-shaped overflow into the bay. The solid matter retained by sedimentation and screening was removed from the boxes, after gypsum and charcoal had been mixed with it, and spread upon a dock to dry. After drying, some of the sludge, it is stated, was used to fertilize the lawns about the hotels.

Mr. Gerhard states in his article that, while this process removed some of the solid matter, the effluent still fouled the bay. The sewage from these buildings is still treated by a separate plant owned and operated by the Manhattan Beach Improvement Co. The present plant, however, was built by Mr. Powers and is similar to the last three described in this series.

The necessity for a thorough sanitary reform at Coney Island led to the passage of an act by the New York Legislature in 1884, empowering the Board of Health of the town of Gravesend, of which town Coney Island is a part, to construct sewers and dispose of the sewage of any district of the town upon petition of a majority of the property owners of the district.

Before a system of sewage disposal was decided upon competitive plans were invited. The plans of Mr. Powers were selected by the board and were afterward approved by Mr. Robert Van Buren, M. Am. Soc. C. E., of Brooklyn. The Coney Island plant was put in operation in 1887 and in 1892 the Sheepshead Bay plant (Eng. News Sept. 29), also in the town of Gravesend, was put in operation.

The plan and longitudinal section, Figs. 35 and 36, show the general arrangement and operation of the plant before the use of lime was begun, about a week ago. Lime is now added to the sewage as it enters the first tank. Perchloride of iron has been used from the start as a precipitant and chlorine as a deodorizer, as described in previous issues. The first year the works were operated the sludge was loaded into a scow, the works being close by Coney Island Creek. For the last few years the sludge has been burned in the crematory at the end of the building, shown by plan, Fig. 35. An overhead tramway is provided for moving the sludge after it has been shoveled from the tanks into buckets. Mixing with sawdust is employed to take up the moisture in the sludge and render it more easily handled. This also assists combustion, but is not at all necessary for that purpose. The two illustrations are intended as sketches, merely, scale drawings not being available.

Two 24-in. trunk sewers join into a 30-in. inlet pipe near the works. One of these sewers has a grade of 1 ft. in 1,500 ft. and the other 1 ft. in 2,000 ft., owing to the flatness of the island. The separate system of sewers is used, but a little roof water is admitted. Two Davidson pumps are provided to pump the sewage after treatment and discharge it through an effluent pipe into the creek or bay. There are two 50-HP. Wharton-Harrison safety boilers.

The crematory in which the sludge, in addition to the garbage from the town, is burned, was made by the Eagle Sanitary & Cremation Co., of New York and Des Moines, Ia. The Board of Health collects the garbage and employs two men at the crematory, one for night service. In July and the first two weeks in August of this year an average of 100 bbls. of garbage were burned daily requiring about 1½ tons of coal per day. The crematory is run only during the summer months. Everything about the purification works seemed in good shape and was wholly inoffensive when visited on Sept. 12. A marked improvement in the waters of the creek and bay is said to have been effected by the sewerage and sewage disposal systems.

Coney Island, it seems hardly necessary to say in concluding, is a popular seaside summer resort a few miles from New York and almost adjoining Brooklyn. Its summer boarders and visitors combined doubtless exceed 100,000 for a few hours during some days. Its population in June, 1890, according to the Eleventh Census, was 3,313, against 1,184 ten years earlier.

Mr. John Y. McKane is President of the Gravesend Board of Health and Mr. I. G. Ring, is Engineer and Superintendent of Sewers and Water, a system of water-works having been built by the board in 1888 to flush the sewers. We are indebted to Mr. J. J. Powers, C. E., of Brooklyn, for much of the information given in this and the four preceding articles.

THE ROWELL-POTTER SAFETY STOP ON THE BOSTON, REVERE BEACH & LYNN R. R.

We discussed in our issue of Sept. 29 some general problems in connection with the use of automatic stopping devices in connection with fixed signals. As we then stated, a principal obstacle to the introduction of such devices is that they all require more or less apparatus to be placed on every locomotive running over the road. This obstacle, however, practically disappears where the number of engines running over the section of road to be protected is very small; and hence it is reasonable to expect that the first general use of such devices will be on local suburban roads carrying a heavy passenger traffic.

The Boston, Revere Beach & Lynn R. R. has recently applied the Rowell-Potter automatic stop to the signals governing its drawbridge over the Saugus River and also to those governing tunnel approaches and facing point switches. As the road owns only ten locomotives, the cost of their equipment was inconsiderable.

The method adopted for protecting the drawbridge was described by Superintendent C. D. Hammond in a paper read at the recent meeting of the Superintendents' Association. The draw is a swing span of through plate girders giving two 38 ft. openings. According to the Massachusetts statute, drawbridges are protected by gates swinging across the track, and so interlocked with the draw that it cannot be opened until the gates are turned and block the track.

At the Saugus bridge the gates are interlocked with the locking gear of the drawbridge as required by law, and in addition a pipe connection extends back 500 ft. and works a semaphore signal beside the track. The semaphores are of the Koyl parabolic pattern, described in Engineering News of Sept. 28, 1889.

From the semaphore post the pipe connection extends back to a point about 1,400 ft. from the draw, where the track instrument of the Rowell-Potter safety stop is located. This device was illustrated in our issue of May 11, 1889, in connection with a report of tests made on the Old Colony R. R. Briefly the device consists of an inclined plane, set beside the rail. A vertical sliding rod on the engine is forced upward when it strikes this plane and opens a valve exhausting the air from the air-brake train pipe.

An improvement which has been applied on the Boston, Revere Beach & Lynn is an automatic tripping device by which a train finding the ground instrument "down" will raise it to the danger position, where it will remain to prevent the passage of the following train until the signalman returns it to safety at the same time that he moves the semaphore. By the use of a portable track instrument, which can be carried by the rear brakeman or by trackmen, trains can be automatically stopped at any desired point, a much more effective means of protecting the rear of trains or points where the track is broken than the ordinary flag.

THE NEW ELECTRIC WIRE REGULATIONS IN PARIS.

The new regulations issued by the municipality of Paris governing the laying of wires of private electric companies entirely prohibit the placing of such wires in sewers or other underground conduits located between the curbs, and demand the laying of such wires under the sidewalks. The materials used in the conduits must be approved by the proper municipal officers, who are also to specify the position, exterior diameter and required depth of the conduits. The most favorable positions, near the surface of the streets, are reserved for the municipal electric light conduits. In order to avoid crossing streets to make house connections a conduit must be carried under the sidewalk on both sides of the street except in very narrow streets. Whenever a conduit crosses a street, it is to be made accessible by a manhole on one side. In very important thoroughfares each side must be furnished with a manhole. If several companies are laying wires in the same street, a common conduit must be employed, the accruing costs to be shared equally between them.

Electric wires of private companies are not to be carried closer than 3.28 ft. to the front walls of houses, which space is to be reserved for the laying of municipal wires. The connections are to be carried in conduits of smaller diameter to the limits of the house. Other branches from the conduits and transformers are to be placed outside the street.

The application for a permit for laying electric wires must be accompanied by detailed plans, for the preparation of which the municipal records and plans of sewers, water conduits, etc., may be consulted. The general plan drawn to a scale of 1-1000, must show the proposed conduits with house connections and the number of lamps. The amount of power to be supplied, the position and material of the cables and the size and material of the proposed conduits must be specified. The details must be shown on a scale of 1 in 20 to 1 in 50.

Before the pavement is disturbed, the company must pay the city for the proper relaying of the pavement at the following rates per sq. meter:

Macadam.	Asphalt.	Wood.	Flagging.
$0.56.	$3.00.	$3.80.	$0.95.

Foundations are charged extra at $0.75 per sq. m. for sand and $1.50 for concrete. Curbing is charged at $1.29 per lin. m. (39 cts. per ft.)

PERSONALS.

Mr. J. C. Slocum, of Chicago, formerly Mechanical Engineer of the World's Columbian Exposition, has been retained as consulting engineer for a large tin plate plant to be erected in the West.

Mr. Joseph E. Dore has been appointed Sanitary Engineer at Montreal, Que. He has been engaged in railway work in Canada, and is a member of the firm of Dore & Charbonneau, engineers, architects and surveyors.

Mr. Arthur Dewey Hall, of Chicago, Principal Assistant Engineer of the Louisville, New Albany & Chicago Ry., was killed at Delphi, Ind., on Oct. 6, while attempting to couple an engine to a freight train in the absence of the brakeman.

Mr. Henry E. Brawner, of Chicago, has been appointed engineer of erection for the new bridge over the Big Vermillion River, at Danville, Ill. Mr. Brawner was, until recently, Chief Engineer of the Bridge Commission, at Bay City, Mich.

Mr. E. R. Sunable, Chief Engineer of the Chicago, Fort Madison & Des Moines Ry., and the Western Construction Co., resigned his position in August to accept a position as Assistant Engineer on Construction with the Sanitary District, of Chicago, Ill., for the building of the new drainage canal. He also acts as consulting engineer for the railway company.

Capt. Edward Maguire, U. S. Engineers, who has been stationed in Philadelphia for some time as engineer of the Fourth Lighthouse District, died at his residence there last week. He was born in Tennessee 46 years ago, and was graduated from West Point in 1867. He held several prominent positions in the U. S. Engineer Corps, and several years ago published a book on "The Attack and Defense of Coast Fortifications."

Mr. Edward Barrath has opened an office under the firm name of E. Barrath & Co., at 1404 Monadnock Bldg., Chicago, to carry on a general practice as architects and mechanical engineers. Mr. Barrath was, until recently, Chief Architect and Superintendent of Construction of both the mechanical and architectural branches for Swift & Co., of Chicago. They will make a specialty of cold storage plants, machine shops, etc.

Mr. C. F. Potter, U. S. Asst. Engineer, died at Omaha, Neb., Sept. 28. He was a native of Enfield, Mass., and graduated from the Rensselaer Polytechnic Institute in the class of 1878. Ever since his graduation he had been engaged on Government work on the Missouri and Mississippi rivers, and for the past three years he had been in charge of river improvement work in the upper division of the Missouri, above Plattsmouth.

Lieut. Henry L. Ripley, 3d Cavalry, U. S. Army, has been ordered to San Antonio, as Engineer Officer for that department. Lieut. Ripley graduated from the Mass. Inst. of Technology, in 1873, was appointed to the army from civil life, and was formerly in the 12th Infantry, U. S. A. To the best of our knowledge this is the first time that any officer, other than a graduate of West Point, has been appointed to the Engineer Corps of the United States Army.

Mr. R. H. Yeats and Mr. Charles Gibson, civil engineers, have formed a partnership under the firm name of Yeats & Gibson, with headquarters at 80 La Salle St., Chicago. Their business will be railway practice generally, with track work as a specialty. Mr. Yeats was the engineer who designed the Stewart Ave. crossing, illustrated in Engineering News of Sept. 22. Both gentlemen were for some years connected with the Morden Frog & Crossing Works, and now represent the Weir Frog Co., of Cincinnati.

Col. H. T. Douglas, Chief Engineer of the Baltimore & Ohio R. R., has resigned, and Mr. W. T. Manning, Assistant Chief Engineer, has been assigned the duties of Acting Chief Engineer. Col. Douglas succeeded the late James L. Randolph about three years ago. Owing to poor health he obtained leave of absence during the summer, which was spent in Europe and at various summer resorts in this country. He returned to his duties Sept. 1. Mr. Manning has been connected with the company 19 years. He was recently made Chief Engineer of the Belt Railroad Co., to succeed Mr. Richard Randolph.

The firm of White & Clark, Times Building, Pittsburg, Pa., has been organized to carry on the business of consulting engineers, examiners of mines, processes and industrial establishment. Mr. William White, Jr., M. Am. Soc. C. E., M. Am. Inst. Min. Eng., was educated at the School of Mines, and was for eight years Assistant General Superintendent of the Edgar-Thomson Steel Works. He was also for seven years engaged in developing manganese deposits on his own account and in general engineering work in various iron and steel enterprises and in the examination of tin, gold, silver, iron and coal properties. Mr. R. Neilson Clark, M. Am. Inst. Min. Eng., was educated at the University of Pennsylvania, had three years' service in the anthracite coal region and the iron ore beds of the Adirondacks, and had also 14 years' service in Colorado, part of the time in the service of the Denver & Rio Grande R. R. Co., and the Colorado Coal & Iron Co., and the remainder in silver mine management and examinations in Colorado and Utah. He is Secretary of the Engineers' Society of Western Pennsylvania.

Mr. Prosper L. E. Huerne, civil engineer and architect, died at San Francisco, Cal., Oct. 1. He was born in France about 71 years ago. He entered the School of Arts at Chalons, and after education as a civil engineer, he remained for a time in the service of the government of France, and had control of numerous engineering projects of considerable importance, among which was the building of one of the stone bridges over the river Loire. For many years he was employed in the Department of Roads and Bridges of the French government. In 1850 he went to San Francisco, and at once gained a position at the head of his profession in the city, and had charge of much of the work of the elder Pioche. He built the French Hospital and the North Point Docks. Through the influence of engineers Couvreux and Hersent he received the contract for dredging the Atlantic side of the Panama canal. A company called the American Contract & Dredging Co., of New York, was organized to perform the work under the contract, and dividends to the amount of seven millions of dollars were paid by the corporation.

Mr. George F. Wright, M. Am. Soc. C. E., died at Los Angeles, Cal., on Aug. 20, 1892. Mr. Wright was born at Elgin, Ill., Sept. 30, 1848. He entered the Naval Academy, at Annapolis, Md., at the age of 17 years, and, after graduating, spent 4 years in the service, chiefly in cruising along the South American coast. About 1870 he resigned from the Navy and commenced the practice of civil engineering under Messrs. Cleveland and French, and was engaged professionally in Chicago, Indianapolis and St. Paul. He was later employed in the drainage works of Chicago and upon the Michigan Canal. In 1875 he located in Santa Barbara, Cal., and remained there 3 years, until he was obliged to leave the sea coast on account of ill-health. He was next a resident engineer on the Northern Pacific Railway, in the state of Washington, and while in this section he laid out the city of Spokane Falls. For a time he was also a locating engineer on the Union Pacific Railway.

In 1885 Mr. Wright returned to Santa Barbara and was elected City Engineer, and in that capacity examined and reported upon the available water supply for the city. In 1891 he established himself in Los Angeles as a consulting engineer. At the time of his death he was engaged as locating engineer with the Arrowhead Reservoir Co., in San Bernardino Co., Cal. Mr. Wright was elected a Member of the American Society of Civil Engineers on Jan. 4, 1888, and was a frequent contributor on professional subjects to this and other journals of a technical nature.

SOCIETY PROCEEDINGS.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The following are the nominations for officers: President, Eckley B. Coxe; Vice-Presidents, C. W. Hunt, Thos. R. Pickering, Edwin Reynolds; Treasurer, Wm. H. Wiley; Managers, Chas. H. Manning, John Thomson, C. W. Pusey.

NEW ENGLAND RAILROAD CLUB.—At the meeting to be held Nov. 9 at 7:30 p. m., at the United States Hotel, the subject for discussion will be "Higher Speed of Railway Trains; System and Appliances Necessary to Accomplish It." The discussion will be opened by Mr. C. A. McAlpine, Superintendent No. Div., O. C. R. R.

AMERICAN RAILWAY ASSOCIATION.—At the semi-annual meeting held in New York City, Oct. 12, the principal feature was the able address of President H. S. Haines on a "Standard Code for Block Signals," reprinted in our last issue. The Association now includes companies operating 127,000 miles of railway; the Boston & Maine and the Concord & Montreal have joined the Association since the last meeting. The new rules to prevent the misuse of foreign cars presented at the March meeting were adopted, and will go into effect on Jan. 1, 1893. The Committee on Safety Appliances and the Committee on Train Rules are working together on standards for use with block signals and interlocking. The following resolution was adopted:

Resolved, That this Association recommends to all its members that all cars used in the transportation of freight requiring high speed should be equipped with power brakes without delay, and also would urge that this matter be brought to the attention of the owners of such cars by the several roads using them.

The next meeting of the Association is to be held at Chicago on April 12, 1893.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting on Oct. 1, the Secretary announced that Mr. Joseph M. Wilson having declined, on account of press of other business, to serve as the Club's representative to aid the Committee of the American Society of Civil Engineers, by the suggestion of suitable persons to furnish papers for the meeting of the World's Congress Auxiliary of the Chicago Exposition, the President had appointed Mr. John C. Trautwine, Jr. Upon motion, the meeting confirmed this appointment.

Mr. Strickland L. Kneass read a paper on "The History and Development of the Injector," giving a detailed description of the Giffard injector as originally constructed, and the improvements devised to overcome the objections urged against it. The self-regulating principle, as embodied in the movable combining tube and the double jet injector, was explained, and interesting statements were given regarding the extended use of the injector as a boiler feeder at the present day. The paper was illustrated by a large collection of working models, showing the development of the injector from the earliest invention to the best types now in use, and also by blackboard sketches.

Mr. Carl G. Barth gave an interesting blackboard discussion of the "Distribution of Pressure in Bearings," maintaining that the center of pressure in an ordinary step bearing should be taken at half the radius, instead of two-thirds, as is usual. After considering a number of theoretical questions relating to cylindrical bearings, Mr. Barth gave some practical suggestions regarding their application to machine construction, and concluded by showing the advantage of placing and proportioning all bearings according to the principles demonstrated.

L. F. Rondinella, Secy.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on Oct. 5 papers were read on "Combination Bridge Building on the Pacific Coast," by Alfred D. Ottewell; and "Some Notes on Foundation Experiences," by Alfred P. Boller, M. Am. Soc. C. E., and were discussed, as noted in our issue of Oct. 12. These papers, in accordance with the new rule, will be published in the October number of the Transactions, and written discussions will be received up to Dec. 15. The time for written discussions to be sent in is extended on the following papers to Nov. 15: "Test of Power Taken to Drive Electric Street Cars," "Motive Power for Street Railways," and "Strength and Weathering Qualities of Roofing Slates." These papers will all be published in the September number of the "Transactions," which has just been sent to press.

At the meeting on Oct. 19, a paper on "Railway Signals and Signal Engineering," was read by Mr. J. P. O'Donnell, the English signal engineer, and of this we shall give particulars later. A paper will be read on "Construction of a Cheap Dam Across the Roanoke River near Salem, Va.," by Oscar Saabye. It is given as an illustration of a somewhat difficult work, accomplished with a very small expenditure; and it is not claimed to be a design to be followed except under like circumstances. The dam was built to close a break in a dam previously built at the same site. The river is a mountainous stream with rapid fall, and subject to extreme and violent floods. At the site of the dam it had a width between low water banks of 150 ft., but in the time of floods it overflows the south bank, requiring an extension of the dam on that side. The previous dam had been washed away a number of times, and the last break left a gap of about 70 ft. width, with 10 to 12 ft. depth of water on a rough, hard bottom, which was supposed, from soundings, to be rock, but was found to consist of large boulders. The cost of repair was strictly limited by the owner to $2,500. A coffer-dam was built inclosing the break, and joining with the shore on the south side. It consisted of crib-work 6 ft. wide, filled with stone, and puddled outside. It was twice carried away by high water, but finally the bottom was laid bare by the use of two centrifugal pumps, each with 6-in. suction. The timbers of the permanent crib work were fitted to the bottom and laid in cement mortar. It had a width from out to out of 16 ft.; was filled with stones as it was built in place, and was finished in 20 working days, after the completion of the coffer-dam. The total cost was $2,400; and about 500 HP. was obtained at this low cost.

AMERICAN INSTITUTE OF MINING ENGINEERS.—The autumn meeting was held at Reading, Pa., Oct. 11, 12, 13 and 14. The headquarters were at the Neversink Mountain Hotel, a large, new and well appointed hotel on a summit overlooking the city and the Schuylkill valley, and reached by an electric railway of which we shall give some particulars later. The route from New York, by the Central R. R. of New Jersey to Allentown and thence by the Philadelphia & Reading R. R. to Reading, is a very interesting one. The Central R. R. of New Jersey is doing a good deal of track work on its line west of Bound Brook, laying new ties and stone ballast, and there are several new stone stations along the line. The company is changing the color of its cars from yellow to a sepia brown. The Philadelphia & Reading R. R. has some very handsome cars, with rounded corners, giving a long bottom step to the platform.

The first session was called to order about 8:45 p. m., Oct. 11, when Mr. J. L. Boyer, chairman of the local committee, introduced Mr. J. F. Daniell, of the Board of Trade, who delivered an address of welcome in which he gave statistics showing the commercial importance of the city and the wide range of its manufactures. Mr. H. S. Eckert then welcomed the members of the Institute on behalf of the citizens, and Mr. Boyer followed with a few remarks, after which Mr. Birkinbine, the President, read a brief address, referring to the industrial history of the Schuylkill valley. An abstract of this address is given in another column.

The first paper presented was by Mr. N. B. Wittman, on "The Brown Segmental Wire Gun." The gun consists of longitudinal steel segments tightly wound with square steel wire of 0.005 sq. in. area at a tension of 130,000 lbs. per sq. in., there being 33 layers at the breech and 10 layers at the muzzle of a 5-in. breech-loading rifle. We shall publish an abstract of this paper later. An abstract of a paper on the "Zeehan & Dundas Smelting Works, Tasmania," by G. F. Beardsley, was then read by Prof. Pettee. The silver fields of Zeehan and Dundas are on the west coast of Tasmania, 30 miles from Strahan, on Macquarie harbor, and reached by a railway from that port. The fields are in a slate country of Silurian and Upper Silurian age. The ore comprises at present but two classes, carbonate ore and galena. Some of the cubical galenas carry 130 to 150 ounces of silver per ton; others, showing smaller crystals and more or less associated with antimonial mineral, only 10 to 25 ounces. At the smelter the ore, fuel, etc., are raised to the feed floor by two 2-ton belt elevators of the Otis pattern. There are two furnaces, 11 ft. 4 ins. × 3 ft. 4 ins. at the tuyeres, and 20 ft. high from ground floor to feed floor, and the plant is designed for four furnaces. The water for the works is pumped from a creek to a height of 72 ft. by an Austral-Otis pump (Worthington pattern). The plant consists of an engine to drive the elevators, using rope gearing; an engine to drive two No. 6 Baker blowers, and a Cornish boiler 26 ft. long and 6 ft. diameter, with five Galloway tubes in the flue. With the present ore and slag, the furnace will drive at the rate of 80 to 90 tons per 24 hours. The entire plant was constructed at the Austral-Otis Engineering Works, Melbourne, Victoria, Australia. At the close of the paper Mr. Birkinbine referred to the advantages of papers by foreign members and stated that the Council is now taking steps to increase the number of such papers.

Prof. W. J. McGee then read a paper on "The United States Geological Survey," showing by colored maps the areas already surveyed and mapped. The topographical survey maps show the contours in brown, the waterways in blue, and the roads, railways, boundaries, etc., in black. They are not intended to serve as minutely accurate maps for cadastral surveys or engineering work, and the cost of complete ordnance maps would far exceed the amount available. These topographical sheets are used in mapping the geological survey. The cost of the topographical survey, under the present bureau, including lithographing plant, printing and all expenses, is about $4 per sq. mile; that of the geological survey, including library, laboratories, hydrographic measurements, etc., is about $8 per sq. mile; while that of the completed survey, deducting the cost of plant, is rather less than $10 per sq. mile. As the plant is now complete, the cost of work in the future will be less. The meeting then adjourned.

On Oct. 12 a session was held in the morning at which the first paper presented was by Mr. Frank A. Hill, on "The Hill Farm Parrish Mine Fire." The mine is near Dunbar, Pa., and is opened by two slopes. Previous to the disaster, which occurred June 16, 1890, steam was led in pipes down one of the slopes, making the timber and dust very hot, and raising the temperature in the slope so high that men could not work to advantage in making repairs. An 8-in. borehole was being put down for a steam pipe, and was then 505 ft. deep, with over 400 ft. of water. On the day of the accident the hole struck one of the workings, and the flow of water alarmed one of the men, who in running to alarm men in another working, set fire to an escape of gas. The fire caught one of the brattices, and then extended to a train of cars and the timbering of the mine. No gas had been known in the mine for over two years, and it is supposed that it came from an overlying coal bed. Several men were killed, probably by suffocation by the wood smoke, but the bodies were not recovered until March and April, 1892. The paper described the methods adopted in dealing with the fire and reopening the mine. In places the fire was blasted out of the top and sides of the workings. Considerable trouble was experienced in working through the debris. It was found that the face of the coal coked, preventing the rest of the vein from catching fire. The author referred to the desirability of incombustible brattices, and of carrying the steam pipes down through bore holes. Mr. Rothwell referred to the value of papers showing how difficult work had been actually dealt with in emergencies, such records being of much greater importance than published accounts of methods for dealing with mine fires, etc.

Mr. Joseph Hartshorne then read a paper on "The Basic Bessemer Plant of the Pottstown Iron Co." There are two cupolas (provision being made for four), 10 ft. diameter, with 19 tuyeres 6 ins. diameter; three converter vessels, with two hydraulic cranes for handling the ladle. The ingots are 6 ft. 6 ins. long and weigh 5,500 lbs. There is a 13-HP. cinder grinding mill of German manufacture, the product of which is sold as fertilizer (Eng. News, Feb. 27), and also a plant for making bricks for the linings, with a capacity of 10,000 bricks in ten hours, with four men and one engineman. The bottoms of the vessels are repaired with a slurry of tar and broken brick. The pig and scrap process is used. The lime is put in first and the metal poured directly upon it. The metal should be as hot as possible during the early part of the blow, and then cooled down to such a temperature as just to allow of casting without leaving a large scull in the ladle. No sand is placed on top of the ingot casting, and a cast iron plug is put on the mold, but not keyed down. These works were visited on the following day.

Some remarks on "The Manufacture of Crucible Steel for Projectiles" were then made by Mr. J. H. Carpenter, of the Carpenter Steel Works, manufacturer of the Carpenter steel projectiles. Chrome, added as ferrochrome, is added to toughen the steel, and steel has been made with a tensile strength of 285,000 lbs. per sq. in. and an elongation of 1% to 4%; it is also made for an elongation of 6% to 20%. He referred to the increased strength and hardness of modern armor plate, and stated that makers of projectiles are now asked to break or pierce these plates. The meeting then adjourned.

About 12:30 the party left the hotel by the Neversink Mountain Railway, and from the base of the mountain a special train provided by the Philadelphia & Reading R. R. carried them to the city. The first stop made was at the works of Cofrode & Saylor, manufacturers of bridge and structural material. Here I-beams and rods were being rolled, and among the special tools were a saw for cutting cold iron, and a shearing machine for angle irons. The saw is a circular disk, without teeth, running at a very high speed. It melts the iron at the point of contact and leaves a burr formed by the flow of the metal. The shearing machine is driven direct by its own steam engine, mounted on the frame. It has jaws on each side, and the blades move downward at an angle of about 45°, the point entering the root of the angle iron and the edges cutting the two sides. The train then proceeded to the Carpenter steel works, where tool steel was being hammered out in rods under a light steam hammer, no dies being used. The greatest interest, however, was in the casting of projectiles. The men who do this work are very muscular and are swathed in ample bandages, kept soaked with water. When the melting pits are opened a man stands over the pit and lifts out the white hot crucibles or melting pots, which are again lifted and the contents poured into the mold, the conical portion and casting head being poured after the main body has been filled. After being removed from the mold the casting is reheated and hammered between dies by a steam hammer until it is of the true diameter and cross section. The casting head is then sawed off and the projectile placed in an oven. In the machine shop the turning and boring of the shells was watched with interest. The party then

proceeded to the company's office, and enjoyed a lunch provided by Mr. Carpenter. The works of the Reading Hardware Co. were then visited, where several interesting tools used in the making of locks, etc., were seen, as well as the plating of bronze door hinges, etc. Then a visit was made to the Reading Pipe Works, where the red hot plates are run through a machine which curls the edge over, bending the plate into a circular form ready for welding, which is done in a roll train, a mandrel on the end of a long rod giving the interior resistance to the pressure. About 25 car loads of pipe, including all sizes, are turned out per day. The party then returned to the hotel for dinner.

A separate excursion had been provided for the ladies of the party by the local committee, who took them to Mohrsville and then to Mount Penn, the ascent of which is made by a Shay geared locomotive (Eng. News, April 26, 1890), and the descent by a gravity railway. In the evening there was a promenade concert and dance at the hotel which was very largely attended.

On Oct. 13 the party left the hotel at 8:30 a. m. for Reading, there taking a special train, provided by the Pennsylvania R. R., to Pottstown, the first works visited being those of the Pottstown Iron Co. The basic steel plant includes two 10-ton converters, one 13-ton converter, an open-hearth furnace, two cupolas, blooming rolls and tables and gas fired soaking pits. There are also lime kilns, brick works and refractory lining plant, an odorless phosphate plant and a chemical laboratory. Thence the train proceeded to the works of the Ellis & Lessig Steel & Iron Co., which include a nail factory producing 300,000 kegs per year; 20,000 tons of nail plate and 33,000 tons of muck bars are rolled each year. At the Valley mills of the Glasgow Iron Co. was seen a flanging plant with improved machinery for the manufacture of boiler heads, etc., and at the Sotter Bros. boiler works were noticed a punching machine making 6-in. holes in tube plates, and a large power riveter at work on a boiler, the boiler being suspended vertically. The walk through these works led to the plant of the Warwick Iron Co., where the casting of pig iron was in process. The blast furnace at these works is 70 ft. high, and 16 ft. diameter at the bosh. There are three fire-brick stoves of the Hugh Kennedy patent, which were put in operation in September, replacing the former Durham iron stoves. They are 60 ft. high and 20 ft. in diameter. The fuel is 75% anthracite coal and 25% coke. The furnace has a capacity of 45,000 tons per annum, and a specialty is made of mill iron, low in phosphorus and silica.

The train then conveyed the party to the lower works of the Pottstown Iron Co. The blast furnace is 80 ft. by 17 ft., working on basic Bessemer iron, about 3% phosphorus, and having two Weimer blowing engines and three Cowper-Kennedy brick stoves. The rest of the plant is as follows: Nail works, with puddling department having 14 furnaces and 2 trains of rolls, nail plate mill and nail factory; 60-in., 84-in. and 112-in. mills, with coal and gas heating furnaces, hydraulic tables and apparatus for turning plates, guillotine shear, etc.; universal mill with reversing engines, gas furnaces, etc.; and a puddle mill with eight double puddling furnaces. Besides the above plant the works include machine, blacksmith, cooper, carpenter and pattern shops, a testing department, fire department, and electric light department with two Brush dynamos for 64 arc lights and an Edison dynamo for 88 incandescent lights. As a souvenir of this visit each member was presented with a nickel plated paper cutter made from a 6-in. basic steel nail, drawn out and flattened at the end. The party then passed through the Philadelphia Bridge Works, where plates were being stamped by a former on a steam hammer to make buckle plates for bridge floors. Thence the party proceeded to the Hill School, a large and finely situated establishment, where students are prepared for university and collegiate courses, and where a very acceptable and enjoyable luncheon was served. Later in the afternoon the train proceeded to Birdsboro, where a visit was paid to the works of the Pennsylvania Diamond Drill & Mfg. Co. In addition to the diamond drills seen in operation, which drill an annular hole from which the core is removed at intervals by a special appliance on the drill rod, there were some interesting machine tools of large size, including a lathe with horizontal face plate for work of large diameter, a gun-turning lathe at work on the outer casing of the first Brown wire-wound gun, which is being made here, and the wire winding machine for this gun. A paper on this gun was read on Oct. 12, as already noted. An experimental chamber built up in the same way as the gun was shown, and two powder charges were fired in it, under the supervision of Lieut. Whistler, who is supervising the construction of the gun on behalf of the United States Government. The party then returned to Reading and the Neversink Mountain Hotel.

At the evening session the names of new members were read, and the announcement made that the annual meeting will be held in February, 1893, at Montreal, in connection with an international mining congress. Reference was also made to the Department of Mining Engineering at the World's Columbian Exposition, the charge of which has been undertaken by the Institute. A discussion on "Hot Blast Stoves" was opened by the presentation of a paper by Mr. W. C. Coffin, describing the new stoves at the Warwick Iron Works above mentioned, which were said to be the first in which the direct draft system has been successfully employed. Mr. Cook, of these works, said they had been lighted on Sept. 29, so that no particulars could be given as to their performance. When it was decided to abandon the Durham iron stoves which had been in service for seven years, a careful and comprehensive investigation as to the merits of iron and firebrick stoves was made by Mr. Cook and Mr. Birkinbine, and it was finally decided to adopt the latter, selecting the Hugh Kennedy patent, which is a modification of the Whitwill stove, with a capacity of 15,000 to 22,000 cu. ft. of air per minute. One point for which these were selected was the reduction in cost of repairs. The three stoves, 20 ft. diameter and 60 ft. long, cost about $38,000, including everything between the hot blast and cold blast valves, and also including royalties. Dr. Raymond hinted that reduction of expenses for repairs might be bought at too great a price in the way of interest upon first cost, and pointed out also that there was a market for old iron, but none for old firebrick. Mr. Birkinbine said that the selection of the type of stove would have to be made with regard to the circumstances of each case.

Mr. David Baker, of the Maryland Steel Co., then read a brief paper on "The Rock Drill Applied to Opening the Tapping Hole of a Blast Furnace," describing the plan used at the company's works after some experiments. The drill used is a Little Giant, No. 4, of the Rand Drill Co., a somewhat heavier machine than is usually adopted for rock work. It is attached to a frame which can be swung into position, and when the melted iron is reached the three-way cock is turned so that the steam pressure withdraws the bit at once. The machine works quicker and cuts a better hole than the old hand drill. We shall publish an abstract of this paper later. Mr. Lyman then read a paper on the "Mammoth Anthracite Bed," and the following papers were read by title: "The Talc Industry of New York," Axel Sahlin; "Magnetic Character of Ferro-Manganese Containing a Certain Amount of Aluminum," James Gayley; "The Mesaba Iron Range," H. V. Winchell; "Incrustations on Cast Iron," Clemens Jones; "Grahamite in Texas," E. T. Dumble; "The Resgreening of Anthracite Culm Banks," A. W. Sheafer; "Artificial Support of Mines by Means of Anthracite Culm," A. W. Sheafer; "The Wieborgh Luft Air Pyrometer," E. Trotz; "Manganese Steel," H. M. Howe; "The Grading of Pig Iron," E. T. Clymer; "Influence of Modern Improvements in Reducing the Cost of Mining," R. P. Rothwell; "The Mesaba Iron Range," C. T. Howe. A resolution was then passed requesting the Secretary to duly convey the thanks of the Institute to the local committees, managers of works, etc., for their hospitable attentions, and the meeting was then closed.

The only exhibit made was a model of the Richards patent shaking grate, by the Richards Grate Bar Co., of Catasauqua, Pa. The bars have V shaped ribs upon them, and the shaking moves the bars longitudinally, the alternate bars moving in opposite directions. The grate is claimed to be specially adapted for burning pea coal.

On Oct. 14, a large party left Reading on a special train provided by the Philadelphia & Reading R. R., and proceeded by way of Pottsville, Frackville and Mahanoy Plane to the Maple Hill colliery near Shenandoah. The route is a winding one, with sharp curves and heavy grades, through the mountain scenery of this part of Pennsylvania, which is seen to advantage in the autumn when the leaves of the trees are turning color, but the neighborhood of the coal mines is a desolate and repulsive region, with hillsides bare of trees, valleys covered with a level, wet, shiny swamp of washed coal dust through which run streams of black water, and from which rise black and dead tree trunks, and huge culm banks which are filling up the valleys and making a new and unpleasant geological formation. Near the colliery the train got stalled on the grade, and the majority of the party alighted and walked across to the mine. The hoisting plant consists of a pair of engines with cylinders 30×60 ins. directly driving the 12-ft. winding drums, and is capable of hoisting eight mine cars in five minutes, or 1,000 cars per day, each car holding 116 cu. ft. and yielding 2¼ tons of marketable coal. The shaft is 720 ft. deep from track to track, or 753 ft. to bottom of sump; it is 23 ft. by 11 ft. 8 ins., divided into three compartments 11 ft. 8 ins. by 7 ft., two of these being for hoisting and one for pumping. It is completely timbered. The coal veins aggregate 75 ft. 6 ins. to 80 ft. in thickness. From the bottom of the shaft, tunnels aggregating 2,400 ft. in length have been driven north and south, with 1,200 ft. of breast in each. The tunnels or gangways are well timbered. So clean and clear were the gangways, that except at the breasts, it was more like walking through a railway tunnel than a coal mine, but the escape from the expected dirt was amply made up for by the thick and pervading dust at the large coal breaker, where the coal is sorted and the slate picked out as the coal slides down shoots along which men and boys are stationed. The coal is then washed and delivered bright and clean on the cars. The breaker has a daily capacity of 2,000 tons. From the colliery the train proceeded to East Mahanoy Junction, where a complimentary dinner to the members and guests was provided at the Lakeside Park Pavilion by the engineers and operators of Schuylkill County. About 300 persons, including a large number of ladies, were seated at five long tables, and the dinner was followed by a few short speeches, which were very well received. Some of the remarks were more or less appropriately emphasized by whistles of the numerous locomotives in the vicinity, and, as one gentleman remarked, speakers in that part of Pennsylvania take off their hats to the locomotives. At 4 p. m. the train left for Reading, by way of Tamaqua and Port Clinton, and made a rapid run, the heavy standard track of the Philadelphia & Reading R. R. being well suited for high speeds. The rails are heavy, spliced with 30-in. angle bars and six bolts, and there are 16 ties to a rail length, while a large portion of the line is ballasted with broken stone or slag. The heavy freight and coal traffic, however, rather hinders special passenger trains. On arrival at Reading at 5:45, the party finally broke up.

The success of the meeting at Bluff Point, N. Y. (Eng. News, July 7), and at Reading, Pa., shows the advantage of selecting a large hotel with ample accommodation, not in a city, with the many various points of interest which attract members from the business meetings, but at the same time near to points of technical interest. There is more sociability and acquaintanceship in such cases than in cases where the members are mixed more or less with transient visitors at the hotel and are subject to the distraction of individual sight seeing, etc., instead of being kept together. The only point which seems to call for criticism is that rather more time should be allowed for papers and discussions. It will be seen by this report of the proceedings that a large number of the papers on the list were read by title only, and an evening session after a day of tiring travel and sightseeing is not an advantageous time to secure attention to the reading of papers or to bring out discussions.

COMING TECHNICAL MEETINGS.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
Oct. 21, 22, Roanoke, Va. Secy., J. R. Schick, Roanoke.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Nov. 2. Secy., F. Collingwood, 127 East 23d St., New York.
ENGINEERS' CLUB OF ST. LOUIS.
Nov. 2. Secy., Arthur Thacher, Odd Fellows' Building.
WESTERN SOCIETY OF ENGINEERS.
Nov. 2. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.
ENGINEERS' CLUB OF MINNEAPOLIS.
Nov. 3. Secy., F. W. Cappelen, 1023 Hennepin Ave.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Nov. 3. Secy., C. H. McLeod, Montreal, P. Q.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Nov. 4. Secy., E. K. Smoot, 808 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Nov. 4. Secy., O. Von Geldern, 719 Market St., San Francisco.
SWEDISH ENGINEERS' CLUB.
Nov. 5. Secy., P. Valentine. At 251 Union St., Brooklyn, and 646 North 10th St., Philadelphia.
NORTHWEST RAILROAD CLUB.
Nov. 5. Union Station, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Nov. 5. Secy., F. D. Jones, Helena.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Nov. 7. Secy., C. L. Annan, City Engineer's Office.
NORTHWESTERN SOCIETY OF ENGINEERS.
Nov. 8. Secy., F. H. Warner, Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Nov. 8. Secy., Chas. S. Howe, Case School.
DENVER SOCIETY OF ENGINEERS AND ARCHITECTS.
Nov. 8. Secy., Geo. H. Angell, 36 Jacobson Block.
ATLANTA SOCIETY OF CIVIL ENGINEERS.
Nov. 8. Secy., Parker N. Black, Capitol Block.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Nov. 9. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Nov. 9. "High Speed for Trains." Secy., F. M. Curtis, O. C. R. R., Boston.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
Nov. 10. Secy., Edward Mead, Morton Building.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Nov. 10. Secy., R. N. Clark, Pittsburg, Pa.
WESTERN RAILWAY CLUB.
Nov. 10. Rookery Building, Chicago. Secy., W. H. Marshall.
ENGINEERING ASSOCIATION OF THE SOUTH.
Nov. 10. Secy., O. H. Landreth, Nashville, Tenn.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Nov. 11. Secy., D. W. Meeker, St. Paul.
WISCONSIN POLYTECHNIC SOCIETY.
Nov. 14. Secy., M. G. Schinke, City Hall.
ENGINEERS' CLUB OF KANSAS CITY.
Nov. 14. Secy., Waterman Stone, Baird Building.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Nov. 14 to 18. Annual meeting. Secy., F. R. Hutton, 12 West 31st St., New York.
ROADMASTERS' ASSOCIATION OF AMERICA.
Nov. 15, 16, 17. Chattanooga, Tenn., and Atlanta, Ga. Secy., J. H. K. Burgwin, Grand Rapids, Mich.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Nov. 16. Secy., S. E. Tinkham, City Hall.
ENGINEERS' CLUB OF CINCINNATI.
Nov. 17. Secy., J. F. Wilson, 24 W. 4th st.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 17. At Atlanta, Ga. Secy., F. A. Charpiot, Macon.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
Nov. 17. Secy., C. F. Franson, 113 Adams St.
TACOMA SOCIETY OF ENGINEERS AND ARCHITECTS.
Nov. 18. 201 Washington Building.
ENGINEERS' CLUB OF PHILADELPHIA.
Nov. 19. 1122 Girard St. Secy., L. F. Rondinella.
CENTRAL RAILWAY CLUB.
Nov. 23. Secy., S. W. Spear, E. Buffalo, N. Y., Iron Works.
NEW YORK RAILROAD CLUB.
Dec. 15. Secy., H. G. Prout, 73 Broadway, N. Y.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

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CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

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A notable victory for the compound locomotive is that achieved on the Chicago & South Side Rapid Transit R. R., which was equipped throughout with compound locomotives at the start. The enginemen and we believe some of the principal officers of the road were strongly prejudiced against the new machines, and the report was at one time in circulation that the engines were proving more expensive than ordinary engines in fuel consumption. It was even stated by one of our contemporaries that the compound principle was of no use under the frequent and short runs of elevated railway service,—a rather reckless position to take in view of the 37% economy attained by a Rhode Island compound on the Brooklyn Elevated R. R., when tested in competition with a simple engine. (Eng. News, Dec. 27, 1890, and Jan. 3, 1891.)

Apparently the quiet exhaust and the freedom from spark and cinder throwing of the compound locomotive should make it especially suited to elevated railway service, even leaving its fuel consumption out of the question. The best proof of the suitability of the compound for elevated service, however, is found in the fact that the Chicago & South Side Rapid Transit Co., after running its 20 compound locomotives in regular service for nearly four months, has given out contracts for 24 more compounds, duplicates of those already in use. The new locomotives will be required for use as soon as the extension of the line to Jackson Park is completed.

The industrial development of the Schuylkill Valley, Pennsylvania, is a striking instance of the rapidity of the development of the resources of the United States. In another column we give an abstract of the address made at the recent meeting of the American Institute of Mining Engineers, by Mr. John Birkinbine, president of the Institute, by which it will be seen that what may be termed the practical development of the Schuylkill Valley region, which is noted for its collieries, iron works and its manufactures, has all taken place within the last 50 years, although the mining and metallurgical industries really had their beginning 150 years ago. The first rolling mills in this country were at Birdsboro, Pa., and the various industries in this vicinity have been developed until this has become one of the most important industrial centers in the United States. We have only recently concluded the celebration of the four hundredth anniversary of the discovery of this country, and, while of course there was practically no development for many years, the advances made during the last few decades show to how great an extent we are overtaking and surpassing the older countries in many matters of industrial progress.

Major-General O. O. Howard, U. S. Army, commanding the Department of the East, in his annual report to the Government, treats at considerable length of the good service rendered by the militia, or National Guard, in the late serious labor disturbances in various states; and he also strongly recommends certain provisions for improving their efficiency that, coming as it does from such an authority, are entitled to immediate and earnest consideration. General Howard wisely says that to call upon United States troops to quell all cases of minor disturbance is too often resented as an outside interference and is likely to cause bitterness of feeling against the common protector, the General Government. The regular forces should be looked upon as a proper reserve, to be called in only when the state forces, civil and military, find themselves unable to master the situation. On the other hand, it is a sign of healthy government when, as was the case lately in Pennsylvania and New York, the local civil authorities, backed by the local military organizations, can readily put down and adjust outbreaks and lawlessness of a serious nature. In these cases both parties were composed of men living under the same laws, and the law-abiding class maintained control without outside aid or interference.

The late work performed shows that the National Guard has reached a degree of excellence never before attained; and, while this body of citizen soldiers has shown itself useful in maintaining order in the several states, it will also be of the highest value to the General Government, in case of hostilities, in guarding important points pending the formation of a volunteer army. Consequently the National Guard is entitled to generous aid from the national treasury, and the present annual appropriation of $400,000 might well be increased to $1,000,000, says General Howard. In fact, the Government now contributes relatively a much smaller sum to this service than it did eighty or ninety years ago, when the militia was lacking in proper organization and discipline. The one thing especially needed, and upon which the Government could wisely expend a generous appropriation, is the rearmament of the entire National Guard at the same time the new infantry arm is issued to the regular army. General Howard strongly urges this upon the next Congress, and gives as his reasons the present diversity of arms among the militia and the great confusion that would exist in providing them with ammunition in an emergency. Under the present appropriation it would take years to supply the citizen soldiers with the new arms, and meanwhile these troops would be armed with guns of .50, .45, .32 and .30 caliber, with a corresponding lack of efficiency in actual service. The Government now owes much to these men in upholding its general integrity and in maintaining peace within its territory, and in case of foreign war its very existence must depend, for a time at least, upon the state military organizations. It is eminently proper and wise then that everything should be done that would in any way render their equipment more perfect and more nearly approaching the highest modern standards. Our state troops practically represent the only army of a peaceful state; but it should none the less be an efficient army, always ready to maintain peace, within or without.

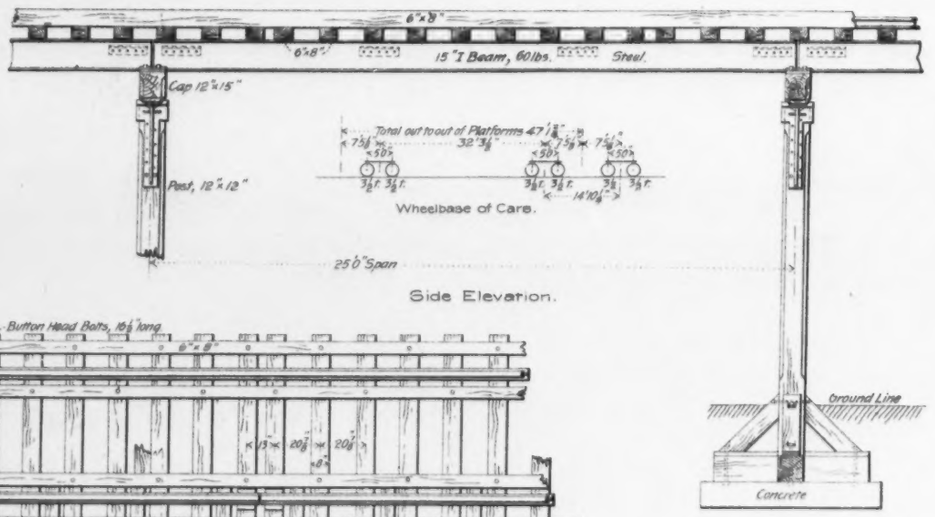
The paper in another column describing the theory of the Westinghouse compound engine is one which deserves careful study by all who are interested in steam engineering work. The claims of the Westinghouse compound for a high steam economy are based on its equal division of the load between the high-pressure and low-pressure cylinders, no matter whether the load on the engine be great or small, thus dividing the range of temperature between the two cylinders in such proportions that the heat loss inside the cylinder will be a minimum. The surprising thing is that this should be effected by such simple means, so that a single piston valve regulates the distribution of the steam to both cylinders.

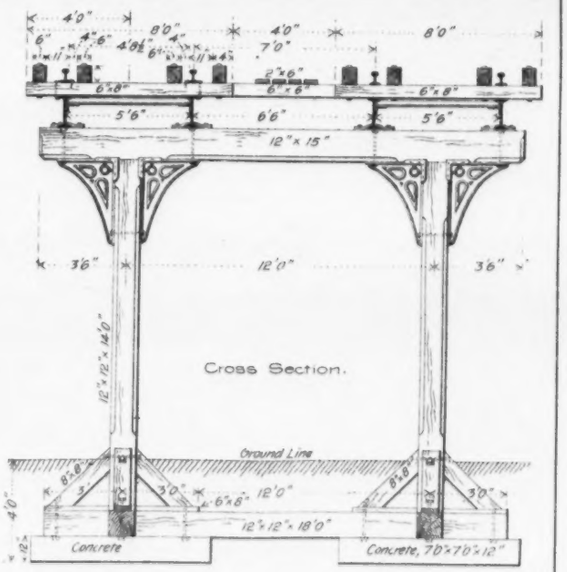
Perhaps not every designer will agree with Mr. Rites in all the points of his discussion, for notwithstanding all that has been written upon the subject, compound engine designing affords much room for diverse theories, as well as diverse results. That a remarkably good economy is obtained by the Westinghouse compound, however, there is no room for doubt; and this taken in connection with the fact that its designers reversed the usual process and made first the correct indicator card and then invented the engine which could produce such a card, is pretty good evidence that their analysis of its action is correct.

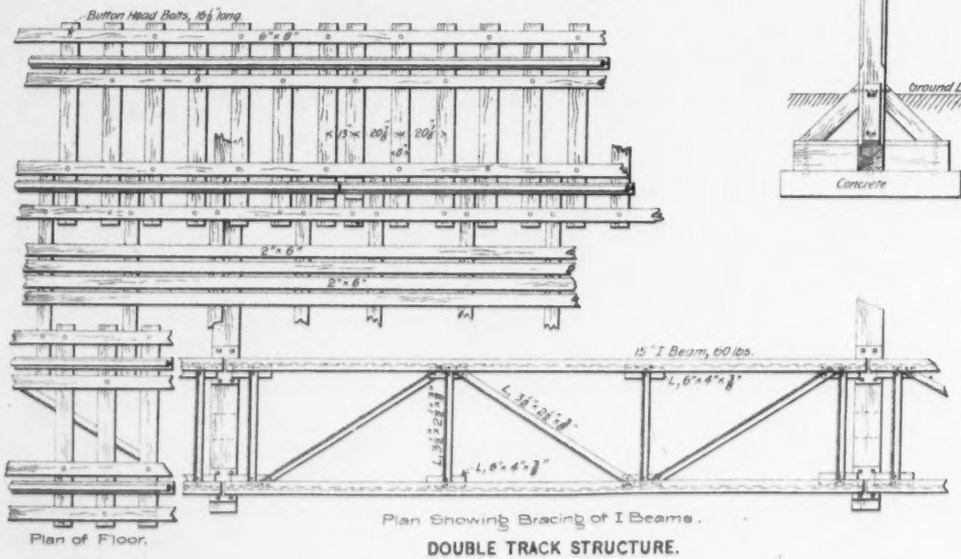
Some Englishmen, at least, are commencing to realize that railway construction in Great Britain can be cheapened under certain conditions, and that it is not essential to maintain one fixed standard for roads of all classes and uses. The Associated Chambers of Commerce have lately directed their Council to lay before the Government the importance of authorizing the construction of inexpensive lines of railway, adapted for slow traffic, to meet the requirements of thinly populated districts. To avoid the present expensive delay of special application to Parliament it is suggested that a general Act should be passed enabling the Board of Trade or County Councils to sanction by provisional order the construction of light railways.

This is a broad departure from present practice for England. Under present conditions no small corporation can afford even to ask for the right to build, for the reason that the cost of the absolutely necessary Parliamentary proceedings may well exceed the total cost of the proposed road. Yet there are many places, even in Old England, that would be much benefited by these light roads and the increased traffic facilities thus afforded, as we have already pointed out more than once. From the proceedings of the above named body it is seen that roads costing about $20,000 per mile are contemplated. This is about one-fifth of the average cost under present practice in England; but the chief benefit sought from the passage of the proposed general Act is evidently the avoidance of the expensive work before Parliament. This preliminary rigid investigation into the needs and resources of the proposed road is well enough in the case of important and competing trunk lines, and is a safeguard to the public that is not to be lightly regarded. But it is unwise to trammel, in a similar way, the development of traffic by cheap connecting roads in districts where the demands do not warrant excessive outlay. The wonderful internal growth of our own country is more than anything else due to the building of these inexpensive lines of railway, that have in many places now served their purpose and are replaced by roads of modern construction and equipment; and England is not yet too old nor too well supplied with lines of railway not to be benefited to a considerable extent by a similar cheap type of construction.

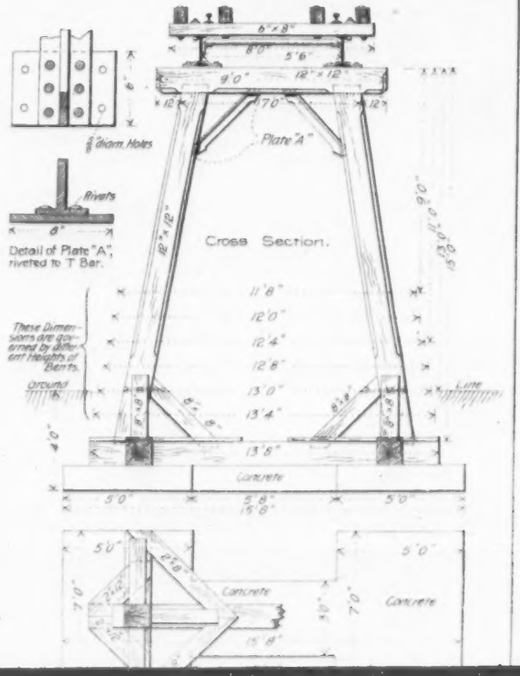
One is almost disposed to believe that the character of the American people is changing, and that they are becoming a distinctly pleasure-loving people, to see New York give itself up, as it did, for three days and nights in succession to the mere making and seeing of pageants. Certainly nothing like it has ever occurred before, and we may well believe that a few years ago it would have been impossible, especially in honor of what is after all a mere historical event and a merely historical name and character, whose personality is not and never has been present in the minds of the people. Washington is still known and loved as a man by most of our people. They have a vivid mental picture of his appearance and personal character, and delight to do honor to him. They also keenly appreciate the blessings which they derive from our form of government. It was, therefore, not surprising that the centennial of his inauguration as the first President under our constitution should have led to a grand popular demonstration. But Columbus is a mere name to all but a very few, and Mark Twain has amusingly illustrated how difficult it is to work oneself up into enthusiasm over a name which is only that. The real motive for the great demonstration, therefore,—for it was a great one,—was a glorification of American progress and achievements, and a growing readiness to take advantage of a good excuse for several holidays. With nations as with individuals increasing

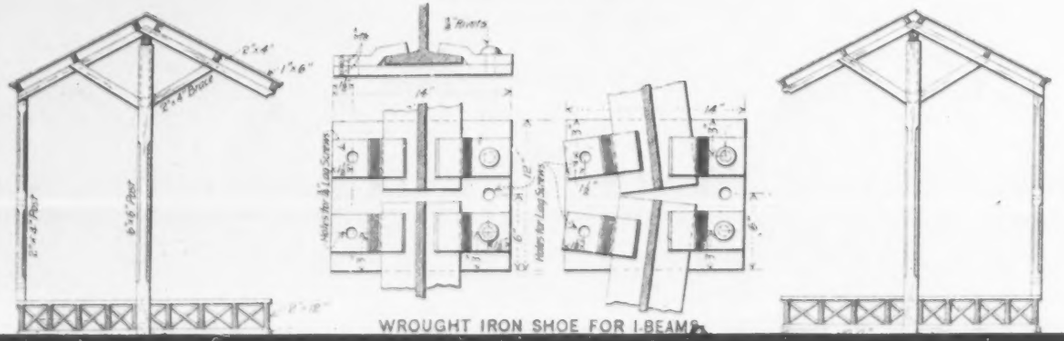


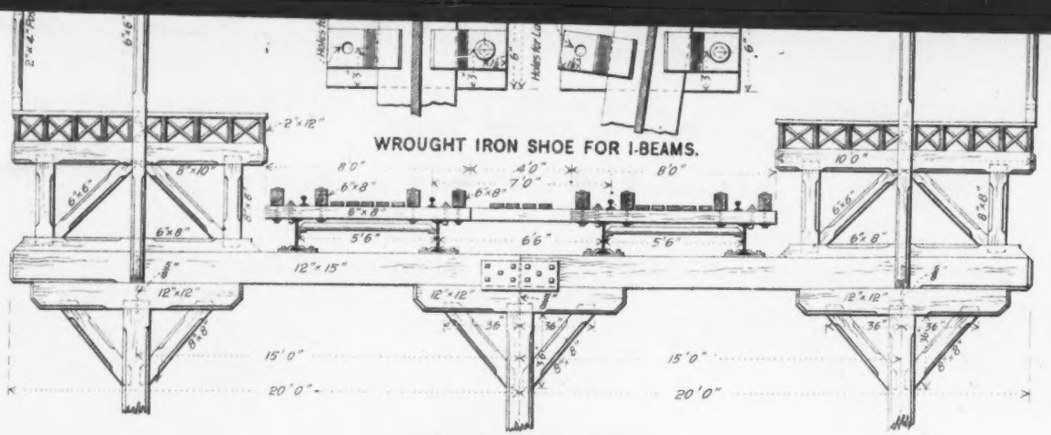


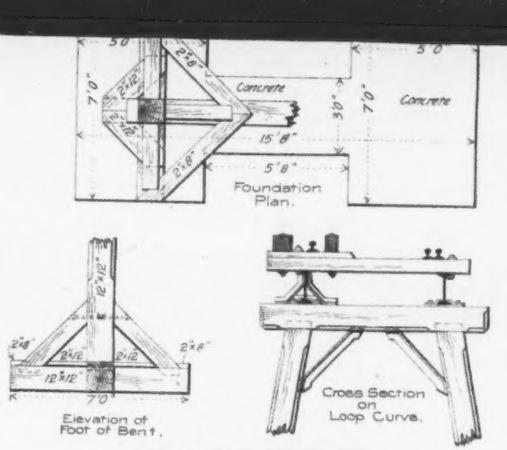


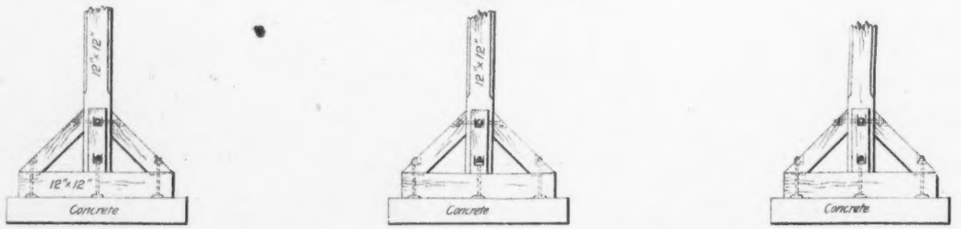
DOUBLE TRACK STRUCTURE.






WROUGHT IRON SHOE FOR I-BEAMS.
CROSS SECTION AT STATION.


Foundation Plan.
Elevation of Foot of Bent.
Cross Section on Loop Curve.
SINGLE TRACK STRUCTURE.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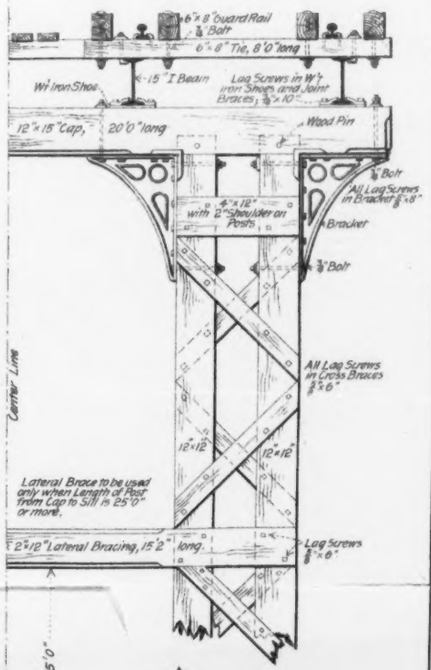
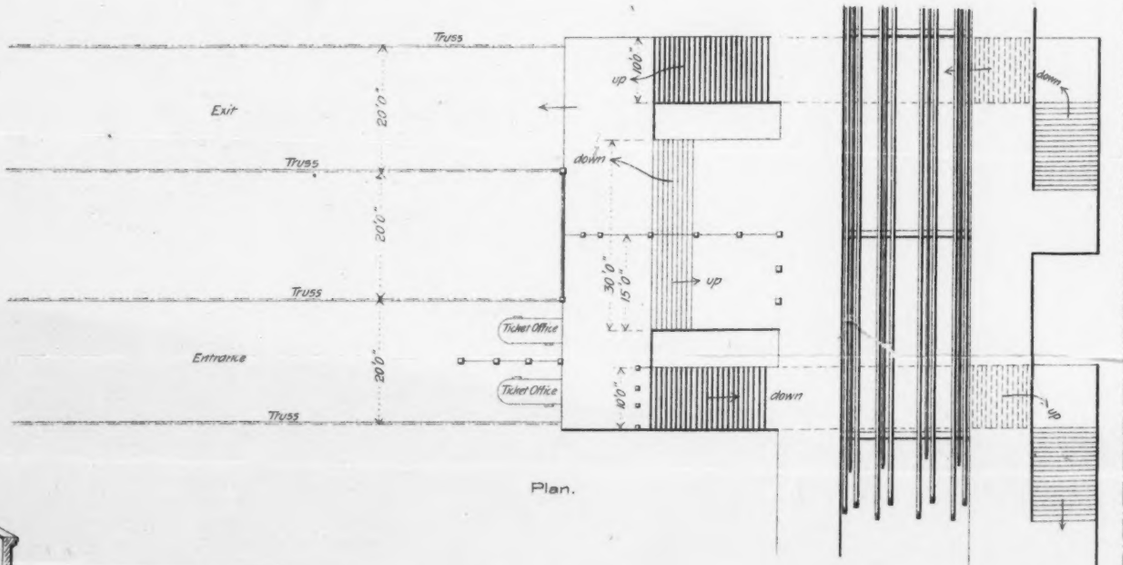
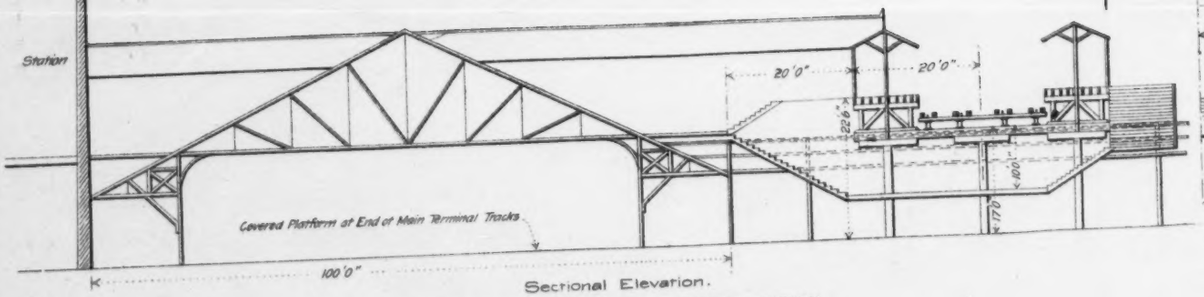

Wrought Iron Shoe
15" I Beam
Wood Pin
Bracket
Center Line
Lateral Brace to be used only when Length of Post from Cap to Sill is 25'0" or more.
Cross Brace, 2"x6"
Bolts

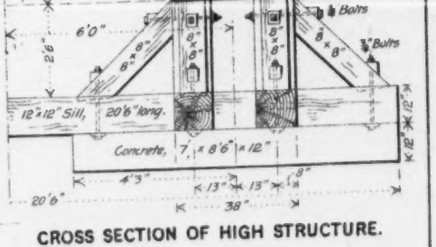

Truss
Exit
Truss
Truss
Entrance
Truss
Ticket Office
Ticket Office
up
down
Plan.

Station



Sectional Elevation.

MAIN TERMINAL STATION AND ELEVATED STATION.



CROSS SECTION OF HIGH STRUCTURE.

ELECTRIC ELEVATED RAILWAY OF THE WESTERN DUMMY RY. CO. WORLD'S COLUMBIAN EXPOSITION.

C. P. Matlack, Chief Engineer. Remington & Co., Contractors.

CHAS. HART & SONS, LITH, 36 VESEY ST., N. Y.

comfort and contentment brings a readiness to mingle more play with the work of life, and that we are learning to do so more gracefully was shown in one gratifying way at least. There was no repetition of the two monstrous "arches" which disfigured the entrance to and exit from Madison Square at the centennial celebration of 1889, and which we had occasion to comment upon at the time. On the contrary, all the official decorations were in excellent taste. The trellis arch at Twenty-second St. was a really beautiful structure, as was also the temporary triumphal arch at Fifty-ninth St., which it is to be hoped will be reproduced in marble.

Two causes only marred the general effect of the celebration, which it seems worth while to note for the benefit of coming celebrations at Chicago and elsewhere, as well as for the tremendous demonstrations which will probably mark the end of the Nineteenth Century and its achievements, as well they may. The first was a tendency to straggle in the processions, which has not much mattered in the small demonstrations to which we have been accustomed in the past, but which is a very serious matter in the great processions of the present and future, both in its marring of the general effect and in the addition which it involves to the fatigue of a million or two spectators. It was most conspicuous, as might have been expected, in the "night pageant," and itself all but destroyed its effect.

It is well enough understood by competent military men that straggling in a long column of men is not reduced, but rather increased by frequent haltings of the head unless provision be made to get the whole column in motion at once after the halt. Otherwise, each company or rank of men only learns of the command to move by seeing the rank in front of it start, after which, each has to require its order to move and make its preparations before it does move. By watching any procession from above it will be seen how very slowly the order to move travels back from rank to rank and how more space is thus lost than gained by every halt. The vanity of the several organizations, each of which likes to cover as much space as possible, increases this evil. All this might be saved by a simple system of signals, either sound or sight or both, as by passing a trumpet signal down the line or waving any high signal, with great addition to the effect of the procession, which should seem like an animated whole rather than a straggling assortment of individuals. With this done, no procession need take so much as two hours to march five miles. Actually, just three hours was taken by the night parade, and only 20 minutes less by the day parade. Similarly the day parade was over 10 miles long, so that less than half of it had started when the head was dismissed. The night parade, though far smaller, was nearly two hours long, the 2,500 wheelmen who constituted half of it being unconsciously straggled, so as to lose all effect of mass, both from lack of discipline and from the delay necessary in starting a bicycle. This was solely due to the lack of any general starting signal, and as Bengal light starting signals would not only have served a useful purpose but added to the brilliancy of the spectacle, the omission to provide them was particularly bad.

This brings us to the second great defect of the celebration, the lack of adequate light for the "night pageant." No spectacle is more beautiful or impressive than a night parade, provided only there be light everywhere and plenty of it, as those who remember the "wide-awake" processions of ante-bellum days will know. To this end the first essential of such a parade should be that every man in it should carry a torch, in addition to which modern resources provide many different and striking ways for providing brilliant light. We do not allude only to electric lights, which are somewhat difficult to manage as adjuncts to a street parade, but there are oxy-hydrogen lights, magnesium lights, locomotive headlights and above all the modern crude petroleum burners used by contractors for night work, and hundreds of which could have been borrowed for the occasion without expense in the vicinity of New York alone. At a trifling extra expense these flames could have been made of many colors, while naphtha flames such as street peddlers use could have been provided in profusion at trifling additional expense. A procession thus lighted and kept closed up so as to pass in an hour or less would have been a truly gorgeous spectacle, making the whole street as light as day: but as a matter of fact there was only one even of the floats which was respectably well lighted, while much of the procession passed in total darkness except for the street lights, as there was not a single torch in the whole parade! A few Chinese lanterns were carried by the bicyclers of their own notion, but these went out early and were never bright enough. The little twinkling lanterns of the bicycles hardly made the darkness visible, and hence the effect of the expensive costumes and decorations worn by many of the riders, as also of some thousands of uniformed men in front, was wholly lost. As a spectacle, therefore, the night parade was almost a total failure, apart from the inordinate delay in starting it, though none of the daily newspapers had the courage to say so. We say this of course, not to find fault with a really grand demostration, but as some warning against future failures of the same kind.

DISTANT SIGNALS AND THE FITCHBURG COLLISION.

The investigation of the recent Fitchburg collision at West Cambridge by the Massachusetts Railroad Commission has resulted in the finding that the blame for the collision rests on the engineer of the freight train which ran into the rear of the passenger train. Reviewing the testimony, it appears from the engineer's own admission that he failed to properly observe some of the signals which he passed in his run from Boston to West Cambridge and that his only excuse for running straight ahead at a high rate of speed was that he knew the passenger train left Boston ten minutes ahead of him and supposed it would be well out of his way. He not only ran faster than he had a right to run in such a fog, but even ran faster than his scheduled time.

The most interesting feature of the testimony, both before the Railroad Commission and at the inquest, was the remarkable obtuseness shown by the railroad employees as to the use and importance of distant signals. It will be remembered that the primary cause of the collision was the engineer of a freight train running past a distant signal standing at caution.

At the first investigation the engineer of the passenger train, which was wrecked, who had been in service on the Fitchburg for ten years as fireman and engineer, testified as follows:

"The distant signals, I didn't notice. I never have depended on them. I depend entirely on the home signal."

Q. "You never take notice of distant signals?" A. "I never have."

Q. "Suppose you saw the distant signal at danger?" A. "I should take measures to stop."

Q. "Then you do take notice of them?" A. "I said I don't depend on them; I look for the home signal for safety before crossing."

Q. "Do you remember seeing the distant signal that night?" A. "I didn't see it. I was not looking for it at all. I don't depend upon it."

The fireman who ran with the engineer testified that he "noticed some signals on the way out." When he got to Cambridge he 'looked for the signal but did not see it so he began putting coal in the fire box.' The reason he didn't see the home signal was because it was so foggy that he didn't know where he was, also he didn't know that he looked for the signal.

These men appear to have been quite intelligent, however, compared with the engineer and fireman of the freight train, whose lack of attention to their duties was the cause of the wreck. The engineer, on whom the blame for the disaster is now officially placed, testified that he did not see the banjo signal at Cambridge because it was dark and foggy. It was the first night he had run out of Boston since last winter. He always depended on the home signal and had not stopped for the banjo signal. He expected the distant signal to be out of order. His fireman said he didn't know where the signals were and didn't look for any. He didn't think he could have seen the distant signal under the conditions of the weather until he got right onto it, and only then if he was looking for it.

A third engineer, who ran a freight which followed the train that caused the wreck, testified that he did not see the distant or home signals at Cambridge and that he had no instructions to slow up if a home signal were not seen.

If this is a fair sample of the manner in which railway employees understand the use of signals, the wonder is that accidents under fixed signals are so few. Apparently the Fitchburg engineers are in need of some sound instruction peremptorily laid down as to the use and meaning of signals; and we know of no reason for believing the Fitchburg employees to be less instructed or worse disciplined than the engineers on most other roads.

But after all is it so strange that engineers should pay slight respect to signals and the rules for their use? Why should an engineer consider the admonition of a distant signal important if he knows that his General Manager counsels strict economy in their installation and that many railways get along without them; or why should he pay great respect to a few fixed signals on 10 miles of his trip when his superior officers provide no signals whatever over the remaining 90 miles?

To illustrate by a concrete example: We recorded about a year ago (Sept. 26, 1891) a grade crossing collision within eleven miles of New York City, due entirely to the total lack of distant signals. Over 75 trains pass over this crossing daily, some of them scheduled to cross within 60 seconds of each other. A watchman is maintained here who operates home signals for both roads, and an expenditure of a few dollars with no increase whatever in the cost of attendance would make the crossing safe instead of dangerous. When intelligent men in responsible charge of railway properties show such ignorance of the value of distant signals and the danger of neglecting their use, is it any wonder that the men who run and fire locomotives do not properly respect them?

Another cause of disrespect to signals is the confusion which exists in their installation on many roads. Is it any wonder an engineer should despair of interpreting his signals when within the limits of a few miles he has banjos, semaphores, disks —all sorts of patterns and all sorts of positions—and signals for switches and reverse movements closely resembling block signals.

For another concrete example, one of the worst disasters which have occurred during the past year had as its primary cause a change of signals of which no notice whatever was given to the engineers.

Most emphatically should the signals on a railway be made so plain that "he who runs may read." The simpler the indications, the better; for especially in fast running at night, an engineman has no time to solve puzzles. It is apparent enough that the most important means of promoting simplicity is to establish uniformity. On a given road it is too plain to require proof that uniformity is absolutely essential to safety, but it is only less needed on all railways. In these days of strikes and lockouts and frequent changes of employment, the engineman may serve one road one year and another the next.

It has been often pointed out that when a man has been taught by years of habit to interpret a sign or signal in one way, there is an element of danger in asking him to interpret it in any other way.

Fortunately we have made great progress toward uniformity since the days when every road was a law unto itself and what meant safety on one road meant danger on another. The standard code of train rules has done great things for the safety of trains moved under the old system; and as Mr. Haines pointed out in his address published in our last issue, a similar standard is seriously needed by the roads using the block system. Such a standard will in no way hamper real progress and improvement, nor need it interfere at all with the greatest necessity, the establishment of thorough uniformity in the signal system of any one road. It must be plain enough that now is the best time to begin the establishment of standards, when the general use of the block system is just beginning, and before the principal railways have expended large amounts in establishing needless and dangerous variations in practice, which it will be the work of many years to abolish.

THE TRANSPORTATION OF GREAT CROWDS.

The transportation lines of New York and its vicinity handled the largest crowds in their experience during the Columbian celebration of last week. The traffic on the elevated railways far exceeded the highest records ever made, and the same thing was true of the Brooklyn Bridge. The following are the recorded numbers of passengers who used these lines on the Washington and Columbian centennial days:

	Manhattan Elevated.	Brooklyn Bridge— Railway	Promenade.
April 30, 1889.....	836,176	170,000	40,000
Oct. 10, 1892.....	945,002	.....	.....
Oct. 11, 1892.....	901,325	.....	.....
Oct. 12, 1892.....1,075,537		225,000	75,000

Of the various railways terminating at New York city it is estimated that on Oct. 12 over 270,000 passengers used the roads terminating on the west side of the North River, apportioned as follows: Pennsylvania, 90,000; Reading, 60,000; Erie, 47,000; Lackawanna, 40,000; West Shore, 35,000. About 120,000 passengers are said to have passed through the Grand Central station and about 25,000 used the Long Island R. R.

It goes without saying that such great crowds cannot be transported as comfortably as the ordinary run of travelers, and the people who go out for such a holiday do not expect it. What they do demand is prompt and punctual train movement. Of course there is a vast amount of grumbling at the managers of transportation lines for things which they are powerless to prevent; at the same time it must be admitted that some railways seem to be far more successful than others in keeping traffic in steady motion notwithstanding the crowds, and part of the wholesale grumbling has perhaps some justification. Notwithstanding the enormous number of passengers carried by the Manhattan Elevated, far exceeding all previous records, it has come in for a good share of condemnation in the public prints. The fact of the case seems to be that with all the available trains in service, crowds accumulated on the platforms at various points of the line faster than they could be carried away. The trains were filled so full as to require long stops at the stations, and thus while an enormous number of passengers were carried, the trains were moved so slowly and were so unbearably crowded, as to give rise to much dissatisfaction.

Handling great crowds which tax facilities to the utmost is a difficult task always. The most common plan, and the best up to a certain point, is to put into service all available rolling stock and employees, and load every car to its fullest capacity. But at times when the rush of traffic exceeds the utmost capacity of the road the weakness of this plan becomes apparent.

For example the elevated lines handle during the rush hours of almost every day an enormous traffic with very fair dispatch (though with considerable discomfort to the passengers) by crowding the cars clear to the platform gates. But when the traffic runs much in excess of the capacity of the road, as it did on the Columbus holiday of Oct. 12, or the March blizzard of 1888, one sees at every station crowds pushing and jostling each other to get on the cars, while those who wish to get off have to fight their way through a tightly wedged mass and against the efforts of those who are trying to get on. Short stops at stations, which are essential to rapid movement of the trains, are not possible; and even if most of the trains manage to discharge and receive passengers with reasonable celerity, the delays of the few worst crowded trains hold back all the traffic on the line. The longer the crowds wait, the more impatient do they become and the more difficult to restrain from fighting their way on board by main force. The result is that the rate of movement of the traffic rapidly falls off just when it ought to be at its highest point. Trains crawl along at a snail's pace and the reputation of the road for efficiency is greatly injured.

The remedy and the only remedy for this state of affairs is to reduce the traffic to what the road can handle with the greatest dispatch. At present the rule on the Manhattan Elevated is to admit passengers to the station platforms as fast as they can deposit their tickets without regard to the capacity of the trains. On occasions of very heavy traffic, as soon as the rush reaches the limit where the rate of train movement begins to fall off, the gates should be closed and no more passengers should be admitted to the station platforms at one time than can easily and quickly find room in the next train. Of course to carry out this plan effectively would require good judgment and firmness on the part of station and train men and a system by which gatemen could be informed of the available room in approaching trains.

That this is a practicable system of handling traffic is proved by experience at Coney Island, where the rush for the trains in the evening would doubtless result in many accidents if the number let through the gates at one time were not restricted to what will comfortably fill a train. The practice of transportation lines abroad may also be remembered. Without going to the French and German extreme of closing the gates when the seats are filled we may close them when the available standing room is taken and thus avoid annoying blockades, the influence of which in embittering the omnipotent public against the railways is not to be underestimated.

We have referred above to the memorable blizzard blockade on the Elevated. That was due also to an excess of traffic over facilities for its movement; but it was the reduced hauling capacity of the locomotives rather than the rush due to the blockade of the surface lines which caused this excess. Had all trains on the Elevated lines been reduced to four cars or even to three cars, they could have been kept in rapid motion, the snow would have been swept off the rails as fast as it accumulated and the waiting crowds on the uptown platforms would have been transported to business with reasonable promptness. The same precaution is a good one for all railways. Beware of overloading engines when the traffic is heaviest. It is desirable to give ample accommodation in the way of additional cars on trains which can safely take them; but it is better to err on the safe side than to have trains stuck on grades or losing time through being overloaded.

The Pullman Palace Car Co. held its annual meeting in Chicago on Oct. 13. The old officers were re-elected and the financial statement for the year ending July 31 showed a total revenue for that period of $10,002,350. Of this amount $8,061,081 was from the earning of cars, and the remainder was from patents, manufacturing, rentals, etc. The disbursement was $6,751,967. The total assets are $53,345,050, and the total liabilities $31,261,370. The company owns or controls 2,239 cars, and 415 sleeping, dining and parlor cars are under construction to meet the demands of the World's Fair. During the last year 5,279,020 passengers were carried and the number of miles run was 191,255,656. In its operating and manufacturing departments the company employs 12,800 persons and paid out in wages, last year, $6,619,156.

The 1,500,000 c. p. Schuckardt search light lately tested in Chicago, and intended for the World's Fair, is reported to have failed to meet the claims of its inventor. It was to throw a shaft of light 15 miles long with good effect; but it lost its intensity before traversing seven miles. The smoky atmosphere of Chicago is not adapted to experiments of this nature, and the proposed new telescope for the University of Chicago will have to be located at a considerable distance from the city itself to enable it to fairly test its power.

Ocean mail contracts were signed by the Postmaster-General on Oct. 13, with the International Navigation Co. These contracts require this company to operate a line of steamers between Southampton and New York with one steamer at least each week. Seven vessels will be required. This company now owns the "City of New York" and the "City of Paris" and five new steamers will be built by Cramp & Sons, of Philadelphia, at a cost of nearly $9,000,000.

Upon the recommendation of Chief Engineer A. Fteley, the Aqueduct Commission of New York made the following changes in assignment of civil engineers:

Mr. Charles S. Gowen, division engineer, placed in charge of the construction of the New Croton Dam at Cornell site.

Mr. Alfred Craven, division engineer, placed in charge of the superintendence of the construction of reservoir "M" on Titicus River, in addition to that at Carmel Dams now under his charge.

Mr. Edward Wegmann, Jr., division engineer, placed in charge of the work of surveys and preparations required for the construction of the Muscoot Dam and of the roads and bridges for the new reservoir on Croton River.

LETTERS TO THE EDITOR.

BUCKET FIRE EXTINGUISHER.

Sir: We have to thank you for kindly-expressed good opinions of our patent bucket fire extinguisher in your issue of Aug. 25. We may mention that it occurred to us in reading the notice that you could not at the time have been aware of the fact that our bucket fire extinguisher is patented in the United States; and that therefore, to make any "similar plant" would be (except under license), an infringement of our patent rights.

Yours faithfully,
Messer & Thorpe.

Chancery Lane, London, England, Oct. 3, 1892.

CHEAP RAILWAY CONSTRUCTION.

Sir: In your issue of 6 inst. in the article on "Cheap Railway Construction," you say, "This instance compares very favorably with Mr. Arthur Pew's 'Cheapest Railroad in the World' (Trans. Am. Soc. C. E., 1890, p. 111), which cost $1,008 per mile for all construction except rails," etc.

Did you mean that a narrow gage road costing $2,261 per mile for all construction except rails and tracklaying, compared very favorably with a standard gage road costing considerably less than that amount per mile, as a specimen of cheap construction? Or did you mean that the comparison was favorable to the theory that the gage has little to do with the cost of a road?

Very truly,
Arthur Pew.

Talbotton, Ga., Oct. 12, 1892.

(We fear we misinterpreted the record, comparing parts of the cost of the narrow-gage line with the total cost of the broad-gage, the comparison being even then sufficiently unfavorable to the narrow-gage theory.—Ed.)

NOTES AND QUERIES.

W. G. wishes to know how to make simple tests for impurities in water, and what class of impurities can be detected. Popular tests of the quality of water are of little value. For detecting sewage contamination some authorities recommend the addition of a few grains of white sugar in say a half pint of water, placed in a clean, colorless, glass-stoppered bottle. After shaking the bottle until the sugar has dissolved, let it stand exposed to the light in a warm room for a week or ten days. If the water becomes turbid, sewage pollution may be suspected. It may be added that should the water remain clear, it still might contain germs of cholera or typhoid fever.

R. K. asks: "Do you think there is any truth in the statement that the corrosive action of the brine that ordinarily drips from refrigerator cars has a bad effect on iron bridges. Does it shorten the life of the floor system?"

There is no doubt that the brine from refrigerator cars will rapidly corrode iron. It was chiefly to prevent this action that the iron lining of the St. Clair tunnel was covered with a thick floor of cement, extending over the lower semi-circumference, before putting the permanent way in place. On an ordinary iron bridge, however, there can be no accumulation of brine. Only such drops as chance to strike the floor beams or lateral bracing can cause corrosion, and at every rain storm the salt will be washed off. In the case of bridges with solid buckle-plate floors, however, there might perhaps be sufficient accumulation to cause serious corrosion. If any of our readers know of such cases we shall be glad to give space to their communications.

G. R. S. writes: "We have an engine with one cylinder 6×12 ins., making 375 revs. per minute with 40 lbs. steam pressure. How many horse power does it give us?" The horse power of an engine may be computed by the following formula, which explains itself on a little study:

$$\text{H.P.} = \text{Mean effective pressure} \times \text{area of piston} \times \frac{\text{piston speed}}{33{,}000}$$

The area of the piston in this case is 28.27 sq. ins. The piston speed is $375 \times 2 = 750$ ft. per minute. The mean effective pressure could only be determined by taking indicator diagrams, and will of course vary with every change of the throttle, governor, load or speed. If we assume it at 15 lbs., we have

$$\frac{15 \times 28.27 \times 750}{33{,}000} = 9.6 \text{ H.P.}$$

From this quantity some 10% must be deducted for the friction of the engine itself, leaving a little over 8½ H.P. as the total delivered at the fly wheel.

It must be understood that the above is only a guess at the mean effective pressure, and may be very wide of the mark.

THE ENGINEERING SCHOOLS OF THE UNITED STATES.

XXVII.

(In order to comply with a second request for opportunity to correct returns, we again postpone the completion of our summary of Distribution of Time, publishing instead the following article out of its turn:)

Membership in the Am. Soc. C. E.—Percentage of Successful Engineers from the Several Colleges.

In a certain rude, and yet, it seems to us, perfectly fair way, the membership of the American Society of Civil Engineers may be said to represent the successful fraction of the engineering profession, viz., those who have followed the strict line of their profession with relatively great persistency and success, with or without a subsequent departure in other allied occupations. For the past 15 years at least it has not been possible for any one to obtain admission to the society as a member,—however great his acquirements or standing in other lines,—unless he had risen to the rank of Chief or Principal Assistant Engineer, or had held a nominally lower rank on large works which was equivalent in responsibility to the positions named in smaller works. In other words, the intention has been—and with some possible individual exceptions, the practice—to admit no one as full member unless his past record warrants the belief that he is already fitted by experience to take sole charge of engineering works of some magnitude and importance. The requirements for admission are at least as high as in any other society in the world, and sensibly higher than in any other American Society, though the American Society of Mechanical Engineers is now approaching to it. The Mining Institute does not pretend to have any such standard, so that membership in it is only presumptive (and often deceptive) evidence that a man is an engineer at all.

On the other hand the Am. Soc. C. E. is still by no means a thoroughly national society, in the sense of being equally popular with and attractive to engineers in all parts of the country. Throughout the West there is more or less of a feeling of indifference and antagonism to it, as too much of a local New York institution. This feeling, if not the alleged fact on which it is based, has caused the Eastern engineers to be more fully represented in its membership than those of the West. Both in the East and West, but especially in the West, there are many successful engineers who are not members of the society, and, on the other hand, there are of course a few who are members and yet neither very successful nor very able.

But on the whole the society fairly represents the more successful civil engineers, and includes an overwhelming majority of them. It does not represent as fairly, or one might almost say at all, the successful mechanical or mining engineers. There are many such among its members, but numerically they are a drop in the bucket, both of the society and of those branches of the profession. The Am. Soc. C. E. has not been able to imitate the Institution of Civil Engineers by making itself THE society for engineers of all kinds, civil, mechanical, mining or electrical. The Inst. C. E. may be said to be chiefly composed of mechanical engineers.

To ascertain which were the colleges which were most successful in training the successful engineers, and some other related facts, we sent out in April last a blank form of inquiry to every corporate member of the American Society of Civil Engineers, accompanied by an addressed and stamped envelope for response. Out of 1,135 such members, 668* were good enough to respond to our inquiries; most of the remaining 467 who did not respond would probably have done so on a second request; but we considered that the number which did respond was sufficiently representative. As the principal question asked was whether they had graduated from any engineering school, and if so from what, it is possible that a larger proportion of those who were graduates than of those who were not responded. Those who are graduates would feel it to be in a measure due to their "alma mater" to do so. Those who were not, or some of them, might conceivably feel some hesitation in making that fact known.

We have no reason to believe that any of these causes operated to any such extent as to affect the representative fairness of the returns, except that the membership of the society is fuller in the East than in the West, and hence the engineering schools nearest to New York are likely to have a larger percentage in the society than the Western schools, other things being equal.

Classified according to the years in which the members responding were admitted to the society, the returns would certainly seem to be fairly representative of the entire membership, and hence of the successful fraction of the profession. The number of responses from members admitted in each year since the society was organized in 1867 was as follows:

Admitted in	No.		1875	10		1885	31	
1867	8		1876	17		1886	33	
1868	10		1877	15		1887	47	
1869	11	29	1878	12		1888	75	
1870	7		1879	11	65	1889	53	239
1871	4		1880	21		1890	49	
1872	17		1881	19		1891	64	
1873	14		1882	27		1892	24	137
1874	13	55	1883	29		Total.		668
			1884	47	143			

The results shown by these responses are presented in the following tables. Table XXVII. is perhaps the most interesting, showing the number of graduates reported from each home engineering school, as also from foreign schools, and from the few may have been admitted very recently to the new Associate grade of corporate membership, but these are too few to consider.

This column gives the number of graduates in Civil Engineering only, as comparatively very few members are drawn from mechanical or mining graduates. As some such are drawn, however, we give in parenthesis the total number of graduates in all branches of engineering.*

The last column gives the percentage of the potential members from each college who are actually members and as such responded to our circular of inquiry. These percentages are absolutely too small by perhaps one-half owing to lack of full reports, but relatively believed to be perfectly fair.

In this column of percentages the colleges stand in somewhat different order. Excepting the University of Kansas whose large percentage of 50 is based upon too small a number of reports to be accepted as conclusive, though highly creditable to that institution, the Massachusetts Institute of Technology heads the list with the magnificent percentage of 32.2, and (excepting the University of Virginia (29.7%) for like reasons to that just stated for Kansas) Rensselaer follows with the almost equally good percentage of 21.5, with Washington University, St. Louis, an almost equally good third, with 20%. Considering differences of locality, and considering that Rensselaer has not, like the other two, any non-civil graduates to swell somewhat the number of M. Am. Soc. C. E.'s, though they do not swell the total of

Table XXVII. Number of non-graduates and graduates of the several Engineering schools in 668 out of 1,135 corporate members of the Am. Soc. C. E., with the total number of graduates from each college between 1860 and 1884, inclusive, and the percentage of such among those responding. (The numbered colleges, as heretofore, are arranged in order of age, as shown by the year of the first class graduated.)

	No. Admitted as M. Am. Soc. C. E. in							No. C. E. grads. 1850-84 incl.	P. c. now M. Am. Soc. C. E.
	1867-9.	1870-4.	1875-9.	1880-4.	1885-9.	1890-2.	Total.		
Not graduates	10	22	32	48	63	38	213	.....	....
Graduates of foreign schools	1	5	7	8	15	9	45	.....	....
U. S. Mil. Ac.	..	2	2	5	9	3	21	.....	....
U. S. Naval Ac.	..	..	1	..	1	2	4	.....	....
1. Rens. Pol. Inst.	14	11	7	15	33	19	99	462	21.5
2. Lawrence S. S.	..	..	1	5	1	2	9	86	10.5
3. Sheffield S. S.	1	5	1	7	13	10	37	223 (323)	16.6
4. Dartmouth	..	4	..	4	6	2	16	133	12.0
5. Union	2	3	2	1	6	3	17	185	9.2
6. Univ. Mich.	..	.	4	6	8	3	21	198 (229)	10.6
7. Brk. Pol. Inst.	..	..	..	..	1	1	2	103	1.9
8. Pa. Mil. Ac.	..	1	..	..	..	..	1	171	0.6
9. Columbia	..	..	2	1	4	3	10	60 (341)	16.7
10. Wash. and Lee	..	..	..	2	3	..	5	42	11.9
11. Mass. Inst. Tech.	..	..	4	10	12	9	35	109 (258)	32.2
12. Lehigh	..	..	1	2	3	4	10	66 (118)	15.1
13. Univ. Va.	..	..	.	5	2	1	8	27	29.7
14. Cornell	..	..	..	6	7	4	17	176	9.7
17. Lafayette	..	..	..	1	1	1	3	79 (110)	3.8
18. Wash. Univ.	..	..	..	2	4	1	7	35 (67)	20.0
19. Univ. Vt.	..	..	..	..	2	..	2	32	6.3
21. Worc. Pol. Inst.	..	..	..	3	5	3	11	88 (232)	12.5
23. Me. Agr. C.	..	..	..	..	2	1	3	77 (101)	3.9
25. Univ. Pa.	..	..	..	..	3	2	5	84	6.0*
26. Stevens	..	..	..	..	3	1	4	100 (169)	....
27. Univ. Wisc.	..	..	..	..	..	1	1	35 (52)	2.9
29. Swarthmore	..	..	..	..	1	..	1	32	3.1
32. Univ. Cal.	..	..	..	..	1	..	1	62 (105)	1.6
33. Univ. Kans.	..	..	..	..	4	..	4	8	50.0
34. Univ. Minn.	..	..	..	..	..	1	1	14 (16)	7.2
35. Rutgers	..	..	..	1	1	2	4	67	6.0
36. Univ. Ill.	..	..	..	1	2	..	3	22 (42)	13.6
39. Univ. Cinc.	..	..	..	..	1	..	1	15	6.7
40. Princeton	..	..	..	..	..	2	2	35	5.7
45. State Col. Pa.	..	..	..	..	..	2	2	1	....
Pol. Coll. Pa.	..	1	1	4	5	..	11	Not	
Univ. N. Y.	..	..	..	1	3	2	6	Known.	Mean: 342 M.
Univ. Ala.	..	..	..	..	..	1	1	"	
Va. Mil. Ac.	1	..	..	1	3	..	5	"	Am. Soc. C. E
Brown Univ.	..	..	..	..	1	1	2	"	
O. State Univ.	..	..	..	..	1	..	1	"	out of 2,72
Mass. Agr. C.	..	..	..	..	1	..	1	"	
Haverford	..	..	..	..	1	..	1	"	grads. = 12.5
Bowdoin	..	..	..	..	1	..	1	"	
Others	..	1	..	4	7	3	14	"	
Total	29	55	65	143	239	137	668		
Per cent. not graduates	34.5	40.0	49.3	33.6	26.4	27.6	32.0		
Per cent. grads. foreign schools.	5.3	15.2	21.9	8.4	8.5	9.1	9.9		

* If the Polytechnic College of Pennsylvania (of which we know nothing) should be added to the Univ. Pa., the percentage then becomes 19.196, which better accords with the standing of that university.

field. Troy heads the list with a total of 99; then comes Sheffield (Yale) with 37, and the Massachusetts Institute of Technology with 35. Then comes the University of Michigan and West Point (21 each), Cornell and Union (17 each), and Dartmouth (16). The rest are relatively nowhere. The schools named aggregate 247, while the remaining 34 home schools are only represented by 149, and the foreign colleges collectively (including Canada) by only 45.

Such comparison is unfair, however, without considering also the total number of usually eligible graduates from each school. This is given in the last column but one, for determining which a few graduates prior to 1860 were neglected, as were also graduates after 1884, for the reason that they hardly had time since to gain the necessary experience to secure admission to full membership. A civil graduates used for computing the percentage, these three records may be said to stand very nearly on a par, though with the M. I. T. easily leading.

Others may interpret these facts as they will, but no others which we have encountered in the course of this investigation have seemed to us such convincing evidence of the sterling merit of these three institutions for the training of engineers. What the young man who is not a fool wants, when he goes to a professional school is to be trained to succeed in his profession; not to get a kind of half-knowledge and half-training which merely gives him the sheep-skin and the shadow, without the substance; and it is a perfectly fair

* There has been a dropping fire of them for the past six months, and one has come in (but is not included) since this article was written, showing that the failure to respond was chiefly from inadvertence and not from unwillingness to do so.

* This column is made up (with some few corrections) from the tables published in our issues of Aug. 4 and 18, 1892, Tables XIV. and XVII.

(though not precise) gage of the real merit of a school to determine what proportion of a considerable number of graduates do actually succeed.

To be entirely conclusive, however, such returns should cover at least a couple of hundred graduates, and even then they will only tend to show what the school was when they graduated, not what it is to-day. For this reason, inferences to the discredit of schools, which stand low in this list but are otherwise of good repute, should not be drawn, especially when they are represented by comparatively few graduates. The evidence against them is only negative and applies only to their past. In several instances we know it to be more or less deceptive. But where a school stands high in the list it is certainly positive evidence in its favor.

The three schools which stand next to the three just mentioned are Columbia (16.7%), Yale 16.6%) and Lehigh (15.1%). Considering that these schools are so near to New York and have large bodies of non-civil graduates to swell their membership lists somewhat, their percentages are relatively less than might be expected for schools of such standing, but still good. After them come the University of Illinois (13.6%), Worcester Polytechnic Institute (12.5%), Dartmouth (12.0%), Washington and Lee (11.9%), University of Michigan (10.6%), Lawrence Scientific School (10.5% of a very small number), Cornell (9.7%) and Union (9.2%). The rest are relatively nowhere.

The younger colleges may change this record within a few years. Some of them are sure to do so within a few years; but the facts make it clear to us that a number of the older colleges which we have included in our tables as engineering schools are such in a very limited and subordinate sense only. For instance, to mention only some of the older schools, Tuft's College is not represented at all, and the Brooklyn Polytechnic Institute and Pennsylvania Military Academy, by only one or two each.

The low standing of the University of Pennsylvania we do not understand. It certainly has a good standing as a first-class modern school, and perhaps the numerous graduates reported for the "Polytechnic College of Pennsylvania" really belong to it. This last named institution, if it still exists, we have no reports from, and yet it has furnished more members to the Am. Soc. C. E. than Lehigh or Columbia.

The line at the bottom of Table XXVII., of percentages of members not graduates of any engineering school is rather a flattering one to those who have succeeded in working up to a good professional standing without the aid of such training. Even from the first formation of the Am. Soc. C. E. in 1867, when there were only 6 engineering schools of any importance in the country, the self-taught, successful engineers have been the exception. Of those admitted in the three years 1867-9, nearly two-thirds were graduates, and only one-third non-graduates. Troy alone contributed half of the total. During the next ten years the rapidly expanding demands of the profession raised the percentage of non-graduates to 49.3, and the percentage of foreign graduates to 21.9. Since then the expanding supply of good home engineering schools has decreased the percentage of non-graduates to but little over 25% and the percentage of foreign graduates to but little over 8%, the percentage of foreign born members (including Canadians) being 11.9%, as we shall see.

Both of these percentages we may expect to see still further decrease, as the best foreign engineering schools offer no better advantages over the best American schools, to say the least of it, except those of change of scene and language. It is also more than probable that the percentage of non-graduates among the members will steadily decrease to about 15 to 20%; below which it is not, in our judgment, ever likely to fall, as there will always be about that percentage of men whose talents for engineering will develop after their education is completed or in spite of early disadvantages, and the time will never come when such men will be denied an equal standing in the profession upon their merits.

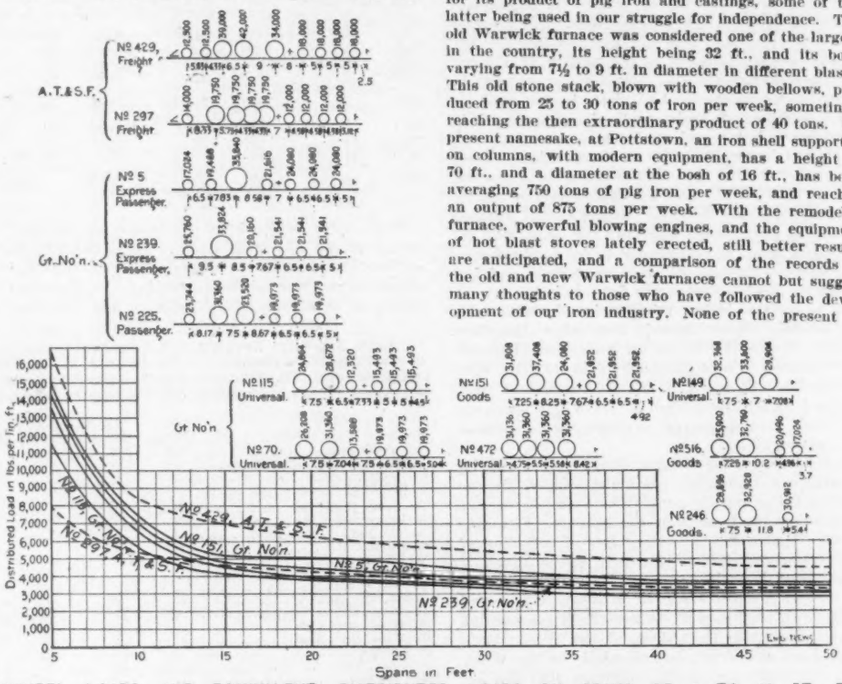
We should add that the "non-graduates" include a very considerable number of graduates from non-technical college courses, and that much more than half of them had enjoyed what is called a good "high school education" or its equivalent. Those who did not, and yet have attained to the high standing which many of them enjoy, deserve all the more honor.

Before proceeding with the summary of the Distribution of Time, we shall complete, in our next issue, the presentation of the remaining information gathered in the circular of inquiry referred to.

A COMPARISON OF THE WEIGHTS OF ENGLISH AND AMERICAN LOCOMOTIVES.

By C. D. Purdon, M. Am. Soc. C. E.,

The accompanying table and diagrams have been prepared to compare the wheel loads and the effect on bridges of some English and American locomotives. In the table ten locomotives of the Great Northern Ry., (England) are compared with the



WHEEL LOADS AND EQUIVALENT DISTRIBUTED LOADS ON SPANS OF 5 TO 50 FT. FOR SOME ENGLISH AND AMERICAN LOCOMOTIVES.

heaviest and with one of the lightest locomotives on the Atchison, Topeka & Santa Fe system. As figures for English train loads were not at hand the diagram was plotted for the locomotives only, and the effect is shown on plate girder spans of from 5 ft. to 50 ft. To avoid confusion in the diagram only four of the Great Northern locomotives were plotted. The equivalent rolling load of each is given in the table.

Distributed Loads Equal to the Engine Loads of the Great Northern Ry. (England), Compared with Atchison, Topeka & Santa Fe R. R. Engine Loads. (Loads Given in Pounds per Lineal Foot).

A. T. & S. F., engine Nos.	Span in feet. 5	10	15	20	25	30	35	40	45	50
429	16,800	8,400	6,933	6,207	5,760	5,415	5,080	4,877	4,495	4,258
297	7,900	4,988	4,856	4,212	3,983	3,664	3,541	3,392	3,339	3,220
Gt. Northern engine Nos.										
5	14,336	9,168	4,778	4,456	4,081	3,695	3,618	4,506	3,488	3,403
239	13,529	6,764	4,509	3,830	3,725	3,472	3,152	3,178	3,119	3,111
225	12,544	6,272	4,181	4,161	3,919	3,563	3,408	3,225	3,176	3,092
115	11,460	5,734	4,143	3,963	3,584	3,296	2798	2,838	2,800	....
70	12,544	6,272	4,068	3,645	2,591	1,333	.....	.....	.....	.....
151	14,963	7,481	5,037	5,030	4,717	4,313	4,000	3,671	3,649	3,592
472	12,544	7,345	6,822	6,203	5,884	5,457	5,026	4,626	.....	.....
149	13,440	6,720	5,244	5,074	4,778	4,649	.....	.....	.....	.....
516	13,104	6,552	4,368	3,731	3,793	3,561	3,392	.....	.....	.....
246	13,171	6,585	4,390	3,950	3,727	3,615	3,411	.....	.....	.....

INDUSTRIAL DEVELOPMENT OF THE SCHUYLKILL VALLEY, PENNSYLVANIA.*

Much of the earlier history of the mining and metallurgical industries of Pennsylvania is associated with the section of the state in which we meet. Mr. Jas. M. Swank, in his work on "The Manufacture of Iron in All Ages" gives 1692 as the date when iron was first made in Pennsylvania, and copies the following verse, as the only record of this production:

"A certain place here is, where some begun
To try some Mettle, and have made it run,
Wherein was Iron absolutely found,
At once was known about some Forty Pound."

The first successful Pennsylvania iron enterprises were the Bloomary forge, built in 1716, and the Colebrookdale blast furnace erected in 1720, respectively three and eight miles distant from Pottstown, and it may be a satisfaction to some who bewail a present depression in trade, and the low prices now ruling, to recall the fact that in 1731 pig iron is reported to have been sold "in large quantities" at the Colebrookdale furnace at £5 10s. Pennsylvania currency per ton, equivalent to $15 gold. In the two decades following 1720, a number of furnaces and forges were located, the plants starting from the vicinity of Pottstown as a center, spreading out toward Reading, and also in other directions. To the southwest of Pottstown was the Warwick furnace, which attained considerable prominence, having been built in 1738 and remained active for 130 years, in that time acquiring a reputation for its product of pig iron and castings, some of the latter being used in our struggle for independence. The old Warwick furnace was considered one of the largest in the country, its height being 32 ft., and its bosh varying from 7½ to 9 ft. in diameter in different blasts. This old stone stack, blown with wooden bellows, produced from 25 to 30 tons of iron per week, sometimes reaching the then extraordinary product of 40 tons. Its present namesake, at Pottstown, an iron shell supported on columns, with modern equipment, has a height of 70 ft., and a diameter at the bosh of 16 ft., has been averaging 750 tons of pig iron per week, and reached an output of 875 tons per week. With the remodeled furnace, powerful blowing engines, and the equipment of hot blast stoves lately erected, still better results are anticipated, and a comparison of the records of the old and new Warwick furnaces cannot but suggest many thoughts to those who have followed the development of our iron industry. None of the present industries in the vicinity of Pottstown are 50 years old, and the development which has been going on for less than half a century has ended in the complete plant erected some five years ago, which has the credit of being the first plant specially erected for producing basic Bessemer steel in the country. The Pottstown Iron Co. is also a pioneer in commercially producing fertilizer from basic slag. The company's works have grown from a small plant employing 200 men to one which now requires 2,000 men to operate its blast furnace, steel works and mills, costing $3,000,000, and turning out nearly 1,000 tons of product daily.

At Birdsboro, iron works have been established since 1740, when the first forge was located at that point. One of the first rolling mills in the country, a slitting mill, and a nail works, were in operation here before the Revolutionary War. The Birdsboro iron works have been owned by the family of the present proprietors since 1790, and the small beginning has developed into a plant of three furnaces producing from 50,000 to 75,000 tons of pig iron, a rolling mill and nail factory, with a capacity of 250,000 kegs per annum, in addition to the Bessemer plant, the diamond drill works and other industries.

The story of Pottstown and Birdsboro can be practically repeated concerning the vicinity of Reading, its industries having been instigated by the earlier de-

* Abstract of the opening address by Mr. John Birkinbine, President of the American Institute of Mining Engineers, at the meeting of the Institute at Reading, Pa., Oct. 11, 1892.

velopments in iron manufacture. For although the production of iron as a metal in Reading can hardly be embraced among the pioneer enterprises, its other industries gave it a prominent place as a manufacturing center, and it has maintained an enviable reputation for the construction of machinery, stoves, hardware, and various productions of iron and other metals.

The earlier furnaces and forges soon located beyond the Schuylkill Valley at points convenient to other deposits of iron ore than the local brown hematites and magnetites, but within a radius of 35 miles of this point the earlier iron industry of the state was established and developed. In Lancaster County was the Elizabeth Furnace (claimed as the first to transport the Cornwall ores), associated with legends of Baron Stiegel, maintaining a ducal mansion. It was at Elizabeth Furnace where some of the first American stoves were made. One of these bearing the inscription (translated from Pennsylvania German) "Baron Stiegel is the man who knows how to make good stoves." On the original Elizabeth furnace, built in 1750, the legend is said to have been inscribed "John Huber is the first German who knows how to make iron." Within the radius of 35 miles is the Cornwall charcoal furnace, the oldest in the country still standing, to celebrate this year its 150th anniversary, and close by is that wonderful mass of soft magnetic iron ore known as the Cornwall ore hills, from which up to the present time 12,000,000 tons have been won, a greater amount of iron ore than has been obtained from any other single locality in the country. This old furnace passed through various changes in machinery equipment, from the leathern bellows to the wooden and iron blowing tubs driven by water power, its last campaigns being made with a steam engine supplementing the water wheel, but it was always blown with cold blast, and worked with an open top. Stone hearths only have been used. Also within the radius was the furnace near Pottsville which first introduced the hot blast and which first successfully produced anthracite pig iron, and in the city of Pottsville was the pioneer furnace which won a liberal premium for having been the first American blast furnace in continual operation on anthracite fuel alone for three months. Within it, again, the first President of the Institute, David Thomas, was instrumental in further solving this interesting problem and demonstrating in 1840 the practicability of the use of anthracite coal in place of charcoal.

The use of bituminous coal naturally followed that of anthracite, and the iron industry was relieved of anxiety as to a sufficiency of fuel, which dependence upon charcoal had encouraged, thus permitting an expansion of the volume of business. For it is doubtful if even with the improved appliances, and with careful reforestation, the United States could have, and could now produce one-fourth of its present output of pig iron, if charcoal was the only fuel available for smelting purposes.

It is unnecessary to refer in detail to the great anthracite coal fields of this state, for in an address presented to the Institute one year ago on "The Fuel Supply of the United States," I called attention to many of its prominent features. I need only say, that although anthracite coal was known to exist prior to the year 1800, it was not until 1820 that any quantity was shipped. Our late member, Mr. P. W. Shaefer, showing in his table the first shipment in that year amounting to 365 tons from the Lehigh region, followed in two years by a shipment of 1,500 tons from the Schuylkill region. We can hardly realize that in the record of a man's life, three score and ten years, the anthracite coal fields of Pennsylvania have grown to exceed an annual output of 40,000,000 gross tons, for the mining of which over $40,000,000 are yearly paid as wages, and who can estimate the advancement which has been caused by the utilization of 800,000,000 tons of fuel which have been taken from the anthracite coal fields of Pennsylvania.

The excursion provided for the Institute passes through the southern into the western middle anthracite coal field, these two basins covering 230 of the 470 sq. miles embraced in the anthracite district. In the territory visited is the Pottsville shaft, 1,586 ft. deep. As the mouth of this shaft is 729 ft. above tide, the bottom is 847 ft. below ocean level, and the bore hole which struck the Mammoth vein was extended 400 ft. below the level of the shaft. But this operation is held in reserve and no mining is done. The collieries now active obtain coal at depths as great as 900 ft., some producing from 375,000 to 450,000 tons of coal annually by breakers which can each handle 2,000 tons of coal per day, and which cost to erect $75,000 each. Attention may also be directed to the powerful equipments of pumping and hoisting machinery connected with most of the collieries, and the bold engineering features which characterize many of the railways in the anthracite coal fields. In the two fields nine veins of coal are found, six of which may be considered as persistent. Numerous sections taken show that these six veins vary from an average thickness of 6 ft. to an average thickness of 33 ft., giving for the six an average total of 75 ft. of workable coal. The largest of these veins, the Mammoth, shows, as an average of 68 sections, 32.7 ft., and the average of 27 sections of the Buckmountain is 13.6 ft. The maximum thickness of some of the veins is locally enormous, the Mammoth occasionally exceeding 100 ft., and the problem now being solved by the mining engineers of the anthracite district is to increase the production by obtaining more coal from a given working, as up to the present time from 30 to 50% only of the coal could be mined, and some of the operations have been able to take out but 20% of the coal in the ground. The systems of stripping coal lying near to the surface, of back filling with culm, and approved mining methods, all tend to increase the percentage of coal which can be mined. Another problem is to reduce the waste in preparing coal, which is 15% or more of the quantity treated, probably 10% being recovered by rescreening, and large economies are obtained by washing and jigging. The underground workings of the Maple Hill colliery are 720 ft. below the surface, and cut coal seams aggregating a thickness of from 76 to 87½ ft. There are six equipments of hoisting machinery, and a large breaker.

With the development of these early industries a canal system was established as a convenient method of transportation, and although this development appeared rapid, it was within the past half century that greater strides were taken, for the Schuylkill valley boasts of the earliest extensive railways constructions, and nearly simultaneouly with the employment of this method of transportation came the liberal exploitation of the coal fields, the use of mineral fuel, the application of hot blast and the utilization of steam power at iron works. Great as these changes are, they in turn are discounted by the history of the 20 years just passed, in which technical investigation has aided practical skill in obtaining better and greater results than had been believed possible. We had learned how to do some things, but can now do better because we know why we do them, and as we gain and apply such knowledge, further advancement may be expected. The resources of the Schuylkill Valley appear to be far from exhausted, when the annual production approximates 15,000,000 tons of anthracite coal, 600,000 tons of pig metal, and an equal amount of rolled iron and steel, much of which is converted into machinery, bridges, roofs, stoves, hardware and other manufactures of iron and steel. Adding the glass, paper, textile and other industries, an impressive total is presented, the appreciation of which is perhaps influenced by strong affection for traditions.

The territory above mentioned as inclosed by a circle described with a radius of 35 miles, using Reading as a center, would embrace all of the industries of the Lehigh valley above and including Bethlehem, all of the East Pennsylvania valley, most of those in the Lebanon valley, those of Lancaster and vicinity, and all in the Schuylkill valley above Norristown. If the radius were increased to 50 miles, almost the entire industries of the Delaware, Lehigh, Schuylkill, Lower Susquehanna, East Pennsylvania and Lebanon valleys, those of the lower coal fields and of Philadelphia would be included; demonstrating that we meet at the center of an important mining and manufacturing district. A census of these industries would show many of them controlled or directed by members of the Institute, for about one-tenth of the names on our roll are domiciled within this area. Therefore the American Institute of Mining Engineers assembles where much of interest and value is presented for investigation, and where guest and host meet in that fraternal feeling, born of a common interest in mining, metallurgy, and kindred pursuits, which gives strength to such organizations.

THE STEAM DISTRIBUTION IN A FORM OF SINGLE-ACTING COMPOUND ENGINE.*

The mechanical performance of the single-acting engine has become well known, but the structural features are usually considered to the exclusion of the peculiar method of steam distribution which has been introduced in its compound type.

It is necessary to note briefly the character of previous work, to understand properly the nature of the departure made in this new type of compound. Broadly stated, all compound engines, with this single exception, may be considered under two heads: those having an intermediate receiver between the cylinders, each with a complete valve, or system of valves, interposed between it and the receiver; and those (known as the Woolf) having no such receiver, but so designed that a port shall periodically act as a passage between the cylinders.

All the energy of inventing engineers since the design of the first compound has been expended in the development of the two forms. The patent records are perhaps the best indication of the amount of thought given to the subject; and the almost unending claims, based on the arrangement of cylinders either in tandem or side by side, with cranks in line or at an angle, oscillating or otherwise, and with valves from one to eight in number, are but variations upon the fundamental principles which distinguish one type from another.

Of the two types, the receiver is better known, although it is necessarily the more complicated. The general choice may be explained by the fact that each cylinder may be treated by the designer as an independent simple engine, with its own complete system of valves, and with the receiver acting as a secondary boiler. While the Woolf type permits a simpler construction, the difficulties attending a proper steam distribution, especially under varying conditions, have prevented a general adoption. In fact, its occurrence is so rare as to be practically unknown.

To appreciate better the difference in the action of the steam in the two types, the following ideal com-

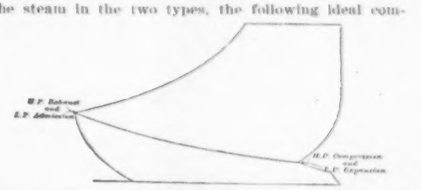


Fig. 1. Diagram from Typical Compound Engine of Woolf Type.

parative diagrams are given, with the distinguishing features in each noted (Figs. 1 and 2). With the aid of these cards, let us trace the objections to each system as a preliminary to the reasoning which led to the correction of the faults in the new type.

In the Woolf engine the resultant enormous compression in the h. p. cylinder with small clearance and early low-pressure cut-off, or the great loss through clearance with a moderate compression, and the inability of any construction to maintain its efficiency under even ordinary changes of condition, has effectually prevented the development of this type. It has been perfectly possible to design a special form of Woolf compound which should be highly economical: but the design invariably possessed no elasticity in its application, and rapidly lost in its efficiency with a change of load or pressure.

The receiver type, however, is much more flexible in this respect, and will allow more variation in construc-

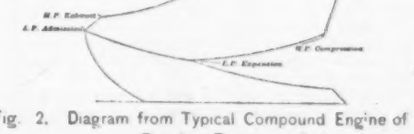


Fig. 2. Diagram from Typical Compound Engine of Receiver Type.

tion and conditions of operation, without unduly increasing the rate of steam consumption, until the range of conditions becomes considerably greater. In all engines of this class, however, free expansion into the receiver, as illustrated in the ideal card, means proportional loss in economy. The receiver is really a clearance space, causing a loss greater or less according to its capacity and to the rise in pressure during the exhaust of the h. p. cylinder. The argument that the energy lost in this expansion is absorbed by the remaining steam in the receiver is in accordance with the conservation of energy, but it is wasted energy, as it is not afterward returned to the engine. Under

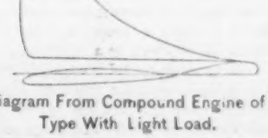


Fig. 3. Diagram From Compound Engine of Receiver Type With Light Load.

constant conditions, the same amount of steam which leaves the h. p. cylinder must enter the l. p. cylinder; and if the initial pressure of the latter be less than the terminal of the former, there is a difference of potential energy in these two conditions that no subsequent manipulation can recover.

Another source of loss in the receiver is the change in pressure and temperature to which it is subjected. There can be no doubt that the laws relating to condensation and retarded re-evaporation hold true with the receiver, as with the cylinders. An increase in the size of the receiver increases the area of condensation and radiation, so that, all other things being equal, the increasing consumption of steam must keep pace with the capacity of the receiver. Recent practice

* Slightly condensed from a paper by F. M. Hites, Pittsburg, Pa., read at the San Francisco meeting of the American Society of Mechanical Engineers.

seems to be in favor of the smaller receiver, so that the steam distribution more nearly approximates that of the Woolf type; but the margin of conditions under which the engine can be operated economically is reduced exactly in proportion as the high economy incident to the Woolf engine is approached in this manner. For a considerable over-load or under-load, the engine must be re-designed with respect to its steam distribution, or operated at a much lower efficiency, as is the law in a greater degree with the Woolf engine.

Inasmuch as it is the exceptional case where an engine is exactly suited to its work, the average commercial performance is far from what can be obtained under test conditions. The evil is more marked with light than heavy loads; and in work demanding extreme variations of power, the h. p. cylinder is frequently forced to supply all the power and in addition drag along with it the l. p. piston, whose cylinder indicates negative work. The indicator card (Fig. 3) will illustrate this action perfectly, and shows that the proper division of temperature between the cylinders was possible only with the load for which the engine was intended.

As the whole range of temperature is covered in the h. p. cylinder, the economy of the engine approaches that of a simple engine; but the net result is a considerable loss over what could be realized from the single cylinder alone, on account of the additional friction and enormous internal negative work of the l. p. cylinder.

It has been but a short time since this question demanded consideration. Heretofore, compound engines have been built for particular kinds of work where load and steam pressure were maintained nearly uniform; while any considerable increase in the original plant was quickly followed by the installation of an engine of suitable power. Since the rapid development of electrical industries, a demand has originated for an engine of high and comparatively constant economy under the widely different conditions incident to this service; and this was particularly true in the case of electric railways, where the average horse-power might correspond with the engine's rating, yet the actual working load would range far above or below this amount the greater part of the time. So great is this commercial loss with high-class compounds under such conditions, that it is still an open question with engineers whether simple engines in a sub-divided form and maintained at a uniform load are not more economical than centralized power, in the form of a compound, subjected to such varying loads.

From the limitations thus described, it will appear that the problem to be solved was reduced to the following:

Given an extreme range of conditions as to load or steam pressure, either or both, to fluctuate together or apart, violently or with easy gradations, to construct an engine whose economical performance should be as good as though the engine were specially designed for a momentary condition—the adjustment to be complete and automatic.

Technically, this may be reduced to read: Design an engine compounded, whose individual cylinders shall be subjected to a constant range of temperature, under constant limiting pressures, with different loads, and whose governor shall automatically readjust the division of the total range of temperature with different pressures at either extreme of the cycle, and at the same time regulate the speed.

To explain perhaps a little more clearly the meaning of the author, the important gain made by expanding steam in two cylinders instead of one is that we do not lose so much heat, since the cylinder walls are not subjected to so great extremes of temperature. Of course the total range of heat in any engine depends on the amount to which the steam is expanded and this depends principally on the point of cut-off, which again depends on the load. Now to get the greatest gain from the use of two cylinders, the range of temperature must be divided between them in such a proportion that the total loss of heat in the two will be a minimum. The rate of loss of heat in each cylinder depends first on the surface which each cylinder exposes, and, second, on the rapidity with which each cylinder loses or takes up heat. To so regulate the range of temperature between the two cylinders as to conform to this law was the task undertaken by the designers of this engine.

A long time was spent in the study of this problem. To correct the faults of either the Woolf or receiver types of compound seemed to require such a complicated valve gear as to be impracticable. The author continues as follows:

The Woolf engine seemed unsuitable, for reasons already explained, although long consideration was given it. In the receiver engine, the little line which marks the fall of pressure between the cylinders was a stumbling block that obstinately intruded itself.

After several months of investigation, the discovery was made of the peculiar value of a receiver of predetermined volume, which should act as a clearance chamber for compression in the h. p. cylinder. This can better be understood by reference to the fragmentary indicator card (Fig. 4).

It may be stated in general that an engine may be designed that will cut off at any convenient point (A) in the h. p. cylinder, and through processes of expansion reach the point (B), the cut-off in the l. p. cylinder, from which point the steam can be compressed to boiler pressure in the h. p. cylinder, and expanded to a proper terminal in the l. p. cylinder. We have so many unknown quantities that we are at liberty to vary any one or several at will, without altering the results. For instance, if the clearance which allows a proper compression in the h. p. cylinder be changed, we are at liberty to change the point of cut-off in the l. p. cylinder so that the same degree of compression is maintained. If, however, it be stipulated that the cut-off in each cylinder shall be equal, then the h. p. clearance can no longer be altered, but must be a certain definite quantity.

If, again, the distribution be effected by a single valve, driven by a shaft governor, the cut-off in each cylinder must be equally variable, and the point (B) will follow a path according to the law of its production, and dependent on the proportionate parts of the engine.

The particular discovery that proved so valuable was, that under these last conditions, the point (B) (Fig. 5),

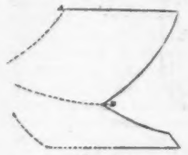


Fig. 4.

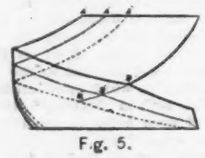


Fig. 5.

followed the path practically of a hyperbola, and that with a proportional clearance equal to the ratio of the cylinders, this path might be made to coincide with the hyperbola of the compression curve..

A variation in the cut-off of the h. p. cylinder varies the point (B) to or from the atmospheric line; while a variation of the l. p. cut-off changes its position in a direction parallel to this line. A simultaneous variation of both cut-offs makes the resultant movement of the point upon which so much depends, and which is determined by the clearance of the h. p. cylinder.

With an independent valve for each cylinder, it would be easy with any convenient clearance to so far vary the cut-off in the l. p. cylinder, that the variation of pressure at this point, due to varying cut-offs in the h. p. cylinder, should cause the point (B) to fall on any h. p. compression curve that should be determined on; but with a single eccentric valve-gear these points

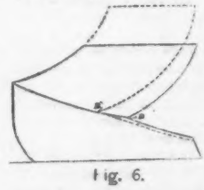


Fig. 6.

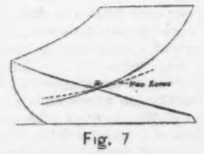


Fig. 7

of cut-off must always be equal and similarly variable, so that the discovery was really essential to the simplicity that was attained.

It seems a lucky chance, although it is really part of the law which controls the movement of this point, that, as the pressure changes, and the h. p. compression varies, the point (B) leaves the path to which it has so closely adhered, and adopts a new one—still a hyperbola—which cuts the steam line at the same point of admission (Fig. 6).

A proper amount of h. p. clearance to suit the various points of cut-off was graphically determined. At a cut-off of one-half, the clearance volume should be the same percentage of the h. p. cylinder volume that that is of the l. p. cylinder volume. At cut-offs on each side of this point to the limit of practical working, the clearance volume varies so little that the angularity of the eccentric rod can be made to introduce a counteracting error, by which the h. p. cut-off changes more rapidly than the l. p. cut-off.

One point further remained to be corrected, however. If the steam were distributed exactly as indicated by the movement of the point B, then the range in the l. p. cylinder would be a little too small at short cut-off. This error is made good by regulating the low-pressure compression explained as follows, by the author:

Under the influence of a single-valve variable cut-off, the l. p. compression rises from a constant pressure, but with a period varying almost as rapidly as the cut-off. The benefit in this case of such a peculiarity is in early exhaust closure with the lighter loads to prevent undue radiation to the condenser, and to raise the temperature of the cylinder so that there will be no surface condensation when the steam port re-opens.

In the later cut-offs, the water of condensation is re-evaporated to a great extent before the point (B) is reached, and a considerable portion of the original steam is recovered for compression in the h. p. cylinder; but, in the earlier cut-offs, re-evaporation does not begin until the h. p. cylinder is shut off from the l. p. cylinder, so that it is important there shall be little or no secondary initial condensation.

The amount of heat radiated during exhaust is dependent somewhat on the speed of the engine, and nearly proportional to the time the exhaust port is uncovered; so that an early compression, with a short cut-off, is valuable in reducing the total radiation to the condenser, thereby making the percentage of loss more nearly constant, as well as reheating the cylinder to prevent initial condensation.

To the very natural question as to the reason for neglecting the radiation in the longer cut-offs, the answer is that the gain in power sinks the percentage of loss from this cause to such a small amount, that the engine really effects a net gain by ignoring that factor.

Moreover, the variable l. p. compression acts as a corrective influence over the point (B), which, if left to follow the course subject to the equally variable cut-

Fig. 8.

Fig. 9.

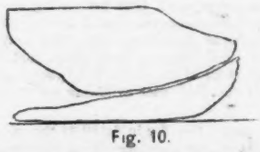


Fig. 10.

DIAGRAMS SHOWING ACTION OF WESTINGHOUSE COMPOUND ENGINE WITH LIGHT, MEDIUM AND FULL LOADS.

offs in the two cylinders, alone, would cause too great a range in the h. p. cylinder and too small a one in the l. p. cylinder.

The variable l. p. compression would, however, overdo the work we have indicated, were the angularity of eccentric rod not interposed as an anti-corrective measure, and the progression of the l. p. compression retarded, while the point (B), thrown slightly from the path to which we have assigned it, varies the h.-p. compression a little on each side of the constant curve of its true path (Fig. 7).

The diagrams (Figs. 8, 9 and 10), reproduced from actual cards, and representing light, medium and full loads, respectively, illustrate the practically constant division of temperature between the cylinders, and are a graphic proof of the successful application of the new method.

The practical results in fuel consumption are represented by the tabulated water rates under different conditions, both condensing and non-condensing.

Water Consumption of Westinghouse Compound Engine with Variable Load.

	Lbs. of water per HP. hour.*						
HP. of engine....	210	170	140	115	100	80	50
Non-condensing...	22.6	21.9	22.2	22.2	22.4	24.6	28.8
Condensing.....	18.4	18.1	18.2	18.2	18.3	18.3	20.4

It would be insufficient to dismiss with so brief a mention the subject of radiation to the condenser, and the influence of the variable l.-p. compression as a partial correction for this loss, and a factor in the development of the constant economy under varying conditions that has been accomplished. A properly variable l.-p. compression may be regarded only secondary in importance to the practically constant h.-p. compression; and as

*We understand this to mean lbs. of dry steam at 100-lbs. pressure per HP. hour.—Ed.

this design has undoubtedly originated the principle of overcoming by a proper compression the otherwise great waste of a large h.-p. clearance chamber, so it is also believed to be the first to practically acknowledge and control the heat of radiation during l.-p. exhaust by a properly variable l.-p. compression.

After the detailed explanations it will be interesting to note, as an evidence of the remarkable flexibility of the practical engine, that the valve adjustment may be set so far from true that the indicator cards will be considerably altered in shape without materially affecting the economy of the engine.

The explanation is that the range of temperature is properly divided between the two cylinders unless the valve error be excessive, because the error introduced by such readjustment on one cylinder is in a measure corrected by a balancing error on the other cylinder. It must be understood that the whole economical result of the engine is directly dependent on the path of the point (B); and that, in the finished locus of the point, every part of the engine has an influence greater or less.

As a type, the engine must be considered as a union of the two older ones, partaking of the nature of each, yet with the objections to either eliminated, and the good qualities of both retained. The receiver is so disguised as to be scarcely recognized; and, as a clearance cavity to the h.-p. cylinder, absorbs all of the compression instead of only a part. On the other hand, the single dividing lip of the valve reduces its functions to resemble those of the Woolf type.

Ordinary possible derangements have little or no influence in changing the division of temperature and the consequent economy of the engine; yet a radical change in dimensions, such as the shape of the valve which contains the clearance space or in the proportion of the cylinders, would necessitate an entire new design, in which every other part should reconform to the single departure.

THE Q & C CAR MOVER.

Several devices are in use for moving single cars by hand on side tracks, in yards, etc., and we illustrate this week a new car mover which has been put on the market by the Q & C Co., of Chicago, Ill., and which is said to be different from any similar device now used. It is neatly made and weighs about 30 lbs. In the accompanying cut A shows the position of the car mover on the axle so as to push the car from the operator, and B shows it in position to pull the car toward him.

The device is quickly and easily applied to the axle of the car, where the force is concentrated so that a heavily loaded car is easily started or moved, and the labor of moving cars by hand is claimed to be reduced to the minimum. The device is self-

The Q. & C. Car Mover.

adjustable to any build of car or truck, has instantaneous grip and release, quickly gains momentum and retains the same when gained; can be worked between cars so as to open them up, and gives the operator power to move a car in either direction without changing his position. The working faces are smooth, and the wear upon them is very small. The working grip of the mover on the axle of the car is obtained by a sharp pull on the handle of the car mover, so that, with a little practice, the operator is enabled to take advantage of the momentum gained and thereby keep the car moving at a rapid rate of speed. One man can move a loaded car quite readily and with comparatively little effort.

This car mover is said to have been thoroughly tested on the Pacific coast by railways and others handling cars, and to have given very satisfactory results in service.

A CONCRETE-DEPOSITING BAG.

In an article on subaqueous foundations in "Engineering," the method followed by Mr. Wm. Shield, M. Inst. C. E., at Peterhead, N. B., is described. The purpose is to prepare a level bed for concrete blocks over a broken rock bottom in a convenient depth of water. Briefly described, this is done by taking careful longitudinal sections along the outer and inner faces of the foundations, and plotting these full size on a floor. Planks are then cut to fit the inequalities and nailed to a longitudinal plank whose upper edge represents the level required.

These planks are then weighed with iron and fixed in place by divers with bolts let into the rock and preferably fastened by wedges, so that the planks may be used again. Before lowering the planks the surfaces which will be in contact with the concrete are covered by jute sacking, with a flap of the same extending 15 or 18 ins. under the concrete. A length of about 20 ft. is dealt with at one time. The concrete may be made of 4 to 4½ parts of good clean sand and gravel and one part of Portland cement, the top being finished off, for 6 ins. in depth,

Bag for Depositing Concrete.

with a rich concrete of 1½ or 2 parts sand and gravel to 1 part Portland cement.

The concrete is lowered in a bag devised by Mr. Shield for the purpose. It is made as shown and the mouth is closed by one turn of a line which is provided with loops, through which a hardwood tapering pin passes. This pin is attached to the tripping line. The folds of the bag hold the pin in position until a slight pull releases it. The bags taper 3 ins. to a side so as to facilitate discharge. They are lowered to the bottom and, when necessary, they are placed in exact position by a diver. The loss of cement is said to be so small that the water is scarcely discolored. Each bag contains 2¼ cu. ft. of concrete.

UNIFORM PRACTICE WITH FIXED SIGNALS.

In the matter of fixed signals, so called, the standard code of the American Railway Association, is silent, passing them by with only the mention that such things exist. And it is in this field of the science that the most can be accomplished toward systematizing and making uniform.

When railways made their maiden bow to the public, and, indeed, for a long time afterward, the volume of traffic was not so great nor the demand for speed so insistent as to either crowd the road or make it necessary to give long notice to the engineer when stops were required. Gradually, in this country, rapidly, in England, this state of affairs changed, and crowded roads with high speeds became the rule. For a long time we met the difficulty with more tracks on existing roads, or with new and competing lines. In England the high price of real estate and the easily methods of construction made either of these plans undesirable, and other methods had to be devised.

The plan adopted was to give greater capacity to tracks already laid, and that means fixed signals. The block signal system, with distant switch signals, was followed by interlocking, and later by electric locking. Naturally, the greatest amount of signaling is done upon double track roads, for it is there that crowded tracks are found, else the second track would not have been built. Such a road, furthermore, has in addition to all signaling used on single tracks some appliances peculiar to itself, and some of the double track roads are now very completely protected.

In fact, the use of the different safety appliances of this nation is increasing so rapidly that something very soon must be done toward the unification of methods and ideas, or we shall find ourselves in the condition of the Chinese civilization, crystallized to such an extent that any change will be too positive, and we shall go along in our separate ways, each entirely at variance with the other; and this broad and beautiful country of ours will be plastered with semaphores of different shapes, colors and sizes, and what will mean one thing here will mean another 200 yards away. At this day of detouring trains over the tracks of another company, and of the use of one line of rails by the crews of two or more companies, it seems essential that some uniform method of conveying the different pieces of information necessary for the passage of trains be arrived at. But we must bear in mind that while there should be no difference in the manner of signaling, there always will be differences in what we may call the degree. Some roads will always use signals to a greater extent than some others.

As a first step toward uniformity in signaling practice the committee presented the following queries:

1. Should signals be signs of different colors or shapes, or should they change their indication by a change of position, or by color and position combined where practicable? If shape or position is to be used, how is it to be indicated at night? The practice now is to use all these methods, and sometimes all are used on the same road.

2. What instructions is it necessary to give by signals? In other words, what shall they indicate? As now used these indications are: A. Next switch ahead is—open or closed. B. Proceed under the rules; no orders. C. Stop for orders. D. Be prepared to stop at a distance of 800 to 2,000 ft. E. Stop and wait for clear signal. F. Stop for a time, then proceed carefully to the next signal. G. Proceed at full speed; there is no train on the block ahead; or, stop and wait for the block to be cleared. H. Proceed at reduced speed and look out for train ahead. I. Proceed on a side route.*

3. How shall each of the indications be expressed? Probably the most approved methods now in use express them as follows: A. By a distant signal placed some length in advance of the switch target, and it is used of almost any and every size, shape and position. B. and C. By a train order signal upon the telegraph office so arranged as to show safety or danger. D. Is used almost entirely in interlocking, and is usually of the semaphore pattern with a forked blade; horizontally placed it means "The home signal is probably at danger; be prepared to stop;" placed nearly vertically, "The home signal is at safety." E. This is the home signal used with interlocking. It is usually a blade with a square end. Placed horizontally for stop, nearly—or, on some roads, quite—vertically, for proceed. F. This is ordinarily a home signal as in E, and is used in automatic blocking. It cannot be distinguished from E excepting as its position and significance have been explained by previous instruction. G. This is given by the block signal which is placed vertically or nearly so, for proceed, and horizontally for stop. It is sometimes combined with the train order signal, and must then be supplemented with a red hand signal when necessary to bring trainmen to the office. H. This is also given by the block system. Green is the color, and with a semaphore an angle of 45° to the horizontal, the position I. This is a signal used only in connection with interlocking, and is a separate and sometimes smaller semaphore arm than the one indicating "proceed at full speed."

4. Does each of the different indications mentioned in the different divisions of the second query need a separate color, position or shape?

5 How should signals be placed and how painted to insure their being seen? Present practice varies widely.

6. In the case of the distant signal D should it be used to indicate safety with the main or high speed signal alone, or with the signal for side routes as well? It is now generally used with the high speed route only.

7. Given a junction with several side lines diverging from a main line, how many indications are necessary to be given? Some roads now give but two, one indicating main or high speed line open, and the other "Go carefully, you are going to be put away somewhere," while some use a signal for each track that may be taken.

8. Is it necessary to go to as great expense to make signals plain when they are used for movements from side tracks or for reverse movements on the main tracks (that is, for switching movements), as on the main line in the right direction where they will be approached at full speed? The practice now is to use a less expensive signal, though mostly conforming to the shape of the other.

9. If 8 is answered negatively, how is the saving of expense to be accomplished?

10. How far can the home signal, E, the train order signal, B C, and the block signal, G H, be combined? As now used B C and G H are sometimes combined, and elsewhere G H and E are used in combination.

11. If no combinations are made as above, what arrangement is necessary to keep the multiplicity of signals from being confusing?

12. If B, C, E and G H are combined, how is the indi-

*Condensed from the report of the Committee on Signaling, of the American Society of Railroad Superintendents. J. J. Turner, Supt. Pittsburg Division, Southwest System, P. R. R., Chairman.

*The English use still another called the shunting indication, which means, practically, proceed at a switching or backing-up rate.

cation H to be given without confusing home and distant signal indications, and how is it to be given on the inexpensive signals referred to in the eighth query?

13. Is it safe practice to use the block signal without a distant signal? We believe block signals are now rapidly being reinforced with distant signals at all obscure places.

14. Having in mind that speeds of 100 miles an hour are discussed as probable by eminent authorities, and that high speed freight trains are upon us, how far in advance of the danger point should an engineman receive notice to stop; Present practice requires from 800 to 2,000 ft. with fixed signals.

15. How is it to be made sure that operators and levermen will uniformly give the proper signals? This is now accomplished by interlocking the levers with each other and in some instances with the towers on either side so that only the proper signal can be actuated.

16. How is it to be made certain that signals will be seen and obeyed? This is now accomplished by derailing switches.

17. Are derailing switches in the main track really of any advantage? If so, under what conditions, and can they not be advantageously replaced by some other and safer device?

18. To what extent should trains be made to lock up operators and levermen so as to prevent wrong signals being given or switches thrown in the face of approaching trains?

19. Should signals be reinforced in case of fog? If so, how? In England a man is placed under each signal during a fog, whose duty it is to keep a torpedo on the track whenever the signal is at danger.

A NEW COLLAR FOR MENDING AND TAPPING WATER AND GAS MAINS.

We are indebted to the "Journal fuer Gasbeleuchtung and Wasserversorgung" for the following description and illustrations of a collar for mending breaks in water and gas mains. The claims for the device are that its construction is very simple, and that it affords great security against leakage at high pressures.

As shown in Fig. 1, the two half-cylinders composing the collar are mounted on top of the break by sliding the one into the projecting flange of the

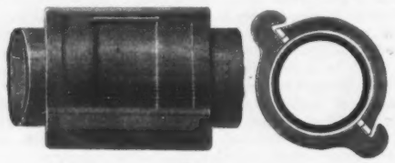


Fig. 1.

Fig. 2.

Collar for Tapping and Mending Gas or Water Pipes.

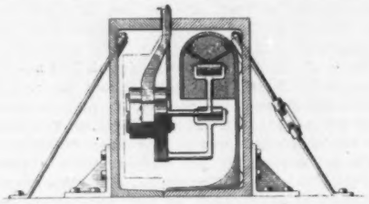
other, the calking being done in the usual manner. The greater the pressure inside of the pipe and the tighter the calking between the collar and the pipe is driven, the more the lead in the longitudinal seams of the collar will be compressed, making the joint absolutely safe against leakage.

Another form of this collar, employed for tapping mains, is shown in Fig. 2. The saving of cost effected by using this collar over old methods at German prices is about 33%. The collar is manufactured by Bopp & Reuther, Mannheim, Germany.

THE BARKLEY CONDUIT SYSTEM FOR ELECTRIC RAILWAYS.

We have from time to time referred to the advantages of the conduit system of electric railways, particularly on city streets where the use of overhead wires is inadmissible, and in our issue of May 19, 1892, we described a successful railway on this system now in operation at Budapest, Hungary. An objection which has been urged to the open-slot conduit system is the liability of the conduit to become filled with water or mud, thus leading to a grounding or short circuiting of the current (Eng. News, Oct. 31, 1891). Another article on conduit systems was published in our issues of March 19 and April 16, 1892.

We illustrate this week a form of conduit construction invented and patented by Mr. R. W. Barkley, of Brooklyn, N. Y., which is intended to



Section of Conduit.

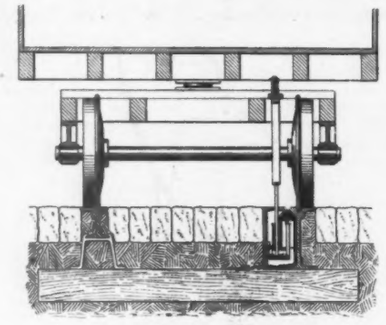


Fig. 1. Cross Section of Track.

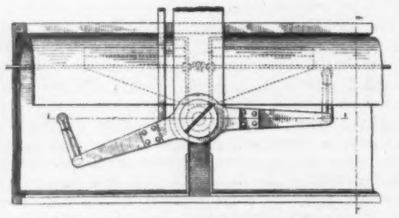


Fig. 2. Longitudinal Section of Conduit.

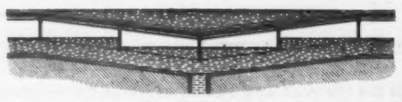


Fig. 3. Diagram Showing Operation of Air Chambers in Flooded Conduit.

THE BARKLEY CONDUIT FOR ELECTRIC RAILWAYS.

obviate the troubles due to the flooding of the conduit. The general arrangement is shown in Figs. 1 and 2, but the conduit may be in the middle of the track if preferred, being then joined by two special rails of the form shown to the left of the conduit. It will be seen at once that the conduit is quite shallow, and along one side of it runs an inverted trough made in short sections with closed ends, so that, on the same principle as that made use of in the diving bell, when the water fills the conduit the air contained in the chamber will prevent the water from rising to the height of the wire. The trolley arm comes down through the slot, along the side of the air chamber, and has a U shaped extension which rises inside the chamber and carries the trolley which makes the connection with the wire. Of course the air chamber is in comparatively short sections, and provision has to be made for the trolley to pass under the diaphragm and still maintain its connection with the wire. For this purpose a double trolley is used as shown in Fig. 2, and to the side of the conduit opposite the air chambers, and placed opposite the intervals between the ends of these chambers, are suitable brackets to depress the arm, or this may be effected by the inclined plane arrangement shown in Fig. 2, springs being used to bring the trolley arm back to its normal position when within the air chamber. Brushes may be attached to sweep mud, ice or snow out of the lower part of the conduit.

In Fig. 3 is shown to an exaggerated scale a longitudinal section through the conduit at the bottom of two down grades, showing the action of the air chambers or "diving bells," as the inventor calls them, in keeping the water from coming in contact with the wire. This arrangement would only be required in such places, or where a long level line is liable to be flooded and has no provision for quick drainage. The chambers may be made of metal, fiber or other material.

The estimate of cost per mile, with a middle conduit, is given as follows:

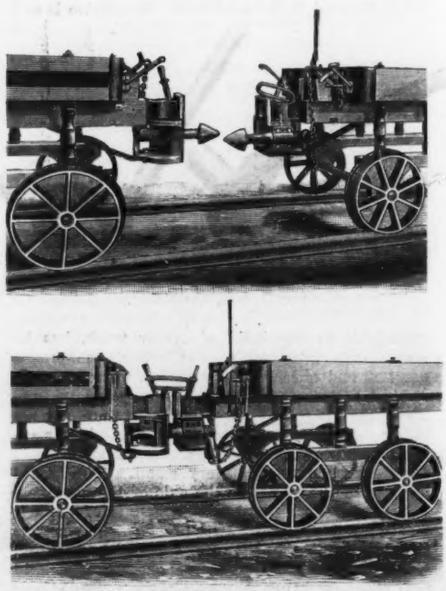
13 tons of 8-in. track rails, at $33	$4,389
2,112 cross ties, at 35 cts	739
352 complete angle bar joints, at $1.50	528
110 tons of conduit channel bars, at $42.56	4,682
18 tons of sheet steel, at $40	720
1,508 lbs. of No. 0 (.307 in.) copper wire, at 30 cts	453
Total	$11,511
Total, with side conduits	$11,268

These figures are exclusive of spikes and bolts, insulating thimbles between the chambers, and the insulating hangers; also exclusive of tracklaying, making and assembling parts of chambers, etc. It is estimated that the cost of material ready for building the road complete and ready for the cars would be from $10,000 to $15,000.

THE LATEST NEW CAR COUPLER.

Despite the action of the M. C. B. Association in recommending the lateral hook coupler, there are still dissenters in New England and elsewhere who take out patents weekly for new types. Few of these command the confidence of capitalists sufficiently to be stocked, manufactured and placed upon the market, but one company to do this for a new device has been quite recently organized, the Althouse Automatic Car Coupler Co., which has taken offices in Chicago as below noted, and which sends us the accompanying cuts illustrating its device, with the subjoined description, which we reproduce in full from the circular. The perspective of the cuts will be seen to be a little out, making the wheels look as if the axles were broken. This is not our fault.

The cuts and description together will enable every reader to study out the good points of the device for himself without further aid from us. One thing is



The Latest New Car Coup'er.

certain. If the coupler problem is never solved, it will not be for lack of inventive talent applied to it.

The Althouse automatic car coupler is another one of the many devices presented for the automatic coupling of cars. To be the inventor of an automatic coupler is in the minds of many railroad men to be a crank. Nevertheless, Mr. Milo Jackson Althouse, President of the Althouse-Wheeler Co., of Waupun, Wis., some time ago undertook to make an automatic coupler which

should meet with no objection from railroad men on the score of expense, durability, or effectiveness, and which should solve in a practical way the problem presented in the effort to obviate the appalling number of accidents resulting in loss of life and serious injury to train men in the coupling of cars. The terribly high percentage of the liability to death and injury is presented in the following: (Statistics omitted.)

The Althouse automatic coupler is very practical, and has been submitted to tests which justify the high encomiums given it by railroad men.

The coupler consists of a double winged arrow having its shaft journaled in one car to one side of the center of the coupling, so as to turn in a horizontal plane, exactly as any shaft turns in its journal, and a slot formed by two vertical bars beveled on their outer edges, which are set in the coupling to the other side of the center of the coupling. The center of the slot is the same distance to one side of the center of the coupling that the hook or arrow is to the other. Then the edges of the wings of the arrow are twisted, so that as the point of the arrow enters the slot on the next car the arrow is turned about one-quarter way round and the wings pass into the slot and back of the bars forming it. The arrow is weighted on one side so that after the arrow wings are in the slot a sufficient distance it automatically turns so the wings are in a horizontal plane behind the bars of the slot.

By this arrangement either end of a car can be forced against either end of an adjacent car and an automatic coupling made; the arrow on one car entering the slot on the other car, and a double coupling being the result; that is, there is an arrow from each car securely caught in the slot on the other. Aside from the great strength thus secured, the liability of the coupling becoming accidentally loosened seems to be entirely obviated.

The Althouse automatic coupler is placed underneath the ordinary link and pin drawhead so that a car having this coupler on it is coupled to a car having the old style drawhead in precisely the same way as if the automatic feature of the coupler were not present. And to insure the highest attainable safety, the link and pin coupling can at any time be made between cars having the Althouse automatic coupler on them, in addition to the double coupling afforded by the arrows.

The Althouse automatic coupler can be operated from either side of the car, without entering between them, or from the top of a flat or box car. By the use of this coupler it will never be necessary to get off the car to uncouple or couple.

We earnestly request all railroad men to call and see this coupler, at our main office, Room 17, 113 East Adams St., Chicago, Ill., or at the inventor's office, Waupun, Wis., where full explanation will be cheerfully given. It covers all the points demanded by railroads and can be operated easier and in less time than any coupler in existence.

A coupler which covers all points demanded and can be operated easier and in less time than any other in existence ought not to be neglected!

SOME LATE ATLANTIC STEAMERS.

As being of interest in contrasting the progress made in the dimensions and power of Atlantic steamers, in the last ten years, we give the following table published by our contemporary, "Industries":

Name of Ship.	Name of Builders.	Date of Construction.	Dimensions. Length over all.	Length between perpendiculars.	Breadth.	Depth.	Displacement in Tons.	Tonnage.	Type of Engine.	Steam Pressure.	I. H. P.	Speed in Knots.	No. of Screws.
Alaska.....	Fairfield Co.....	1881	520 ft.	500ft.	50 ft.	39.5 ft.	9,500	6,900	3 crank compound.	100	10,500	18	1
Servia.....	J. & G. Thomson.	1881	540	515	52	40.75	12,300	7,390	do.	90	10,300	16.9	1
City of Pome.	Barrow Co	1881	600	546	52.3	38.75	13,500	8,140	3 crank compound tandem	90	11,890	18.23	1
Oregon.....	Fairfield Co.....	1883	520	500	54	39.75	12,500	7,375	3 crank compound.	110	12,380	19	1
America.....	J. & G. Thomson.	1884	450	432	54	37.5	9,550	6,500	do.	95	7,354	17.8	1
Umbria.....	Fairfield Co.....	1884	530	501.6	57.2	38 2	13,300	7,718	do.	110	14,320	19	1
City of Paris.	J. & G. Thomson.	1889	560	527	65	39.2	17,270	10,500	3 crank triple.	150	20,000	21.8	2
Teutonic.....	Harland & Wolff.	1890	582	566	57 8	39.4	16,740	9,800	do.	180	18,000	21	2
Normannia...	Fairfield Co.....	1890	520	500	57.25	38	.....	8,716	do.	160	16,000	20.5	2
Campania....	do.	1892	620	600	65.25	41.5	18,000	12,500	do.	160	30,000	.....	2

One interesting feature of the latest ship, the "Campania," is that she approaches closely in length to the ill fated "Great Eastern," lately broken up and generally regarded as a marine monstrosity. This ship, built in 1854-59, by J. Scott Russell & Co., was 680 ft. long between perpendiculars; 83 ft. wide; 58 ft. deep; had a displacement of 27,000 tons at 30 ft. draft; 22,500 gross tonnage; four paddle wheel and four screw engines; 25 lbs. steam pressure; 10,000 HP. collectively, and her designed speed was 16½ statute miles per hour. While in length and gross tonnage the "Great Eastern" is still the biggest ship ever built, in power and speed she was out of the race ten years ago.

THE LOCOMOTIVES OF THE WORLD.

The total number of locomotives in use in the world is figured at about 109,000. This total is distributed among the different continents as follows: Europe, 63,000; America, 40,000; Asia, 3,300; Australia, 2,000; Africa, 700. The "Zeitschrift des Vereines Deutscher Ingenieure," from which we obtain this estimate, says further that the number of locomotives used in the several European countries is as follows:

Great Britain and Ireland	17,000
Germany	15,000
France	11,000
Austro-Hungary	5,000
Italy	4,000
Russia	3,500
Belgium	2,000
Netherlands	1,000
Spain	1,000
Switzerland	900
Remaining countries	2,600
Total	63,000

The same journal credits the United States with 35,000 locomotives (on Jan. 1, 1892 there were 33,563 according to Poor.—Ed.), and allows 2,000 for Canada and 3,000 for Central and South America and the islands. British India is credited with 2,500 and the rest of Asia with 800 locomotives.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Paying for Water Yearly in Advance is Unreasonable.

A regulation of a water company providing that takers of water shall be liable to pay rent for the whole year, whether they actually use for that length of time or not, and to make payment yearly in advance without special agreement is unreasonable, and void. One cannot be held to have made a special contract to pay according to such regulation merely by showing that he has knowledge of the regulation, but the company must show that he expressly assented to it, and agreed to be bound by it. It will be the same where the power is conferred by charter upon a water company or city, to establish prices and rents to be paid for water, subject to the control of the legislature, as that cannot deprive the court of its jurisdiction to adjudicate between parties upon their legal rights. (Rockland Water Co. v. Adams. Supr. Jud. Ct. of Maine, 24 At. Rep., 840.)

Boundary Line of Water Property.

In an action to ascertain and apportion rights in certain water property it appeared that the person who brought the suit took a purchase-money mortgage on land, the dividing boundary between which and certain other land, was described as being " by and with a center line" of a certain pond and river 3,500 ft., which included the water right and appurtenances therewith connected. Eleven years thereafter he purchased the land at a sale under the mortgage. Afterward the mortgagor sold the adjoining land referred to, by deed, having the same description of the division line as the mortgage. During the 11 years prior to purchase by the person suing at the mortgage sale, the mortgagor, while he was owner of all the land, extended the dam on the mortgaged land, raising the pond several feet. Under these circumstances the owner of the adjoining land mentioned acquired no right to maintain the dam and pond as appurtenant to that estate. (Dyer v. Cranston Print Works Co. Supr. Ct. of R. I., 24 At. Rep., 827.)

A Stream as Boundary in Deed.

A description in a deed which runs down the middle of a stream in which the tide ebbs and flows, thence across the stream to the upland on the southerly side, and thence on the southerly side, and of such stream, conveys to the grantee the land on that side between high and low water mark. (Erskine v. Moulton. Supr. Jud. Ct. of Maine, 24 At. Rep., 841.)

The street railways of London may come under municipal control. The London County Council proposes to purchase certain of the lines under the provision of the Tramways Act of 1871, authorizing purchase by the city after a certain number of years. The Glasgow corporation is about to try the experiment of working as well as owning its lines. About 18 years ago the city spent $600,000 in building street railways, which were leased at a rent which has aggregated $750,000, in addition to a heavy percentage in repairs and maintenance. The lessee company has paid a dividend of 8%, and the city authorities think the property can earn this in the interest of the ratepayers.

A new incandescent lamp has been brought out by the Westinghouse Electric & Mfg. Co., of Pittsburg, Pa., which does not infringe the Edison patent, recently in litigation, or any of the patents of other companies, but is fully covered by patents of the Westinghouse company. The new lamp is said to differ radically from those now in use. It requires no platinum and is made in separate parts, so that the incandescent burner can be renewed, and the bulb and other parts of the lamp used over again. Furthermore, by means of an important discovery, the burner is rendered stable, its efficiency increased, its life prolonged, and its normal candle-power maintained. The manufacture of these lamps will be carried on almost entirely by machinery, and the first cost thereby considerably reduced, so that, with the advantages obtained from the re-use of the bulbs, a saving of from 30 to 50% to consumers in the cost of incandescent lamps for a given service will be effected. These lamps will be used with a new socket designed for the purpose, by which a further reduction in the cost of the lamp renewals will be effected, as no base attachment is required to make the connection with the socket.

The proposed railway from Jaffa to Ismailia, on the Suez Canal, is given a fresh impetus by the late opening of the Jaffa-Jerusalem railway. This distance is 195 miles, and it is proposed to cross the canal with a truss bridge 124 ft. high and 394 ft. span. The total earth work is estimated at 2,582,000 cu. yds., and the two other bridges required would have spans of only 33 ft. each. It is also proposed to continue the line through Alexandretta to Scutari, opposite Constantinople.

The gross earnings of 139 railroads for the month of September show an increase of only 2.9% over similar figures for the same month of 1891, according to the "Financial Chronicle." This result, however, is quite favorable considering the very large decrease in the cotton shipment and the smaller spring wheat movement. The best results, as a whole, come from the Southwest, and from the railways in the Middle and Middle Western states, while the principal losses are shown by the Southern and Northwestern roads. Of the total 139 railways, of which figures are given, 51 exhibit losses.

An oil pipe line is being discussed, to connect Atlanta, Ga., with the nearest Ohio wells. The minimum distance would be nearly 800 miles. The Atlanta people are jubilant over the mere prospect of this saving of oil freight to them.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.—Existing Roads.

WILLIAMSPORT & NORTH BRANCH.—A force of about 800 men are now at work on this line from Nordmont to Dohm's Summit, Pa., 18 miles. About four miles are now graded and it is expected to begin tracklaying by April 1, 1893. The road is through a mountainous country and its principal business will be in coal, lumber, brick and leather. There will be two iron bridges 120 ft. and 100 ft. long respectively. The contractors are: E. J. Gaynor, Son & Co., La Porte, Sullivan Co., Pa., and the engineer in charge of work is John Marston, Jr., La Porte, Pa.

CLEVELAND BELT & TERMINAL.—The grading is nearly completed and one mile of track has been laid on this 7-mile belt line at Cleveland, O. The work is quite heavy; maximum grade 52.8 ft. per mile. There is one long high trestle. It is expected to have the line completed by Dec. 15, 1892. The contractors are P. B. Townsend & Co., Jamesville, O., and the engineer in charge of the work is H. A. Kennedy, of Canton, O.

ADIRONDACK & ST. LAWRENCE.—The last spike in this New York railway was driven on Oct. 15. This company was chartered in December, 1889, to build a railway from Herkimer, N. Y., to Valleyfield, P. Q., about 220 miles. The portion of the line in Canada, 31 miles, with several short sections aggregating about 35 miles in New York state, were completed in 1891. From Herkimer to Poland, N. Y., 17 miles, the Herkimer, Newport & Poland R. R., a narrow gage line, was purchased and changed to standard gage. The remainder of the line was built this year. The contractors were: J. W. Westbrook & Co., of New York City, and Ellsworth, Chapman & Lathrop, Corning, N. Y.

OHIO SOUTHERN.—The extension of this railway from Springfield to Lima, O., will pass through Tremont City, Westvill, Degraff, Concord and Clayton. Numerous press dispatches state that construction is to be begun at once.

TOBIQUE VALLEY.—About 300 men are now at work on the 28-mile extension of this railway to Plaster Rock, Nova Scotia, and the grading and bridging are well under way and tracklaying begun. The contractors are: Lawler, Conner & Co., St. John, N. B.

QUEBEC, MONTMORENCY & CHARLEVOIX.—Surveys have been commenced under the direction of W. T. Cronston for an extension from Cape Tourment to Chicoutimi, P. Q.

CENTRAL COUNTIES.—The locating surveys have been commenced for the line from South Indian to Rockland, P. Q., 17 miles.

CHICAGO & WEST MICHIGAN.—It is announced that arrangements have been completed with New York capitalists for the construction of an extension of this railway to Chicago.

Projects and Surveys.

PENNSYLVANIA MIDLAND.—A local paper states that large bodies of men are grading and blasting all along the line of this proposed railway between Stroudsburg and Scranton, Pa., about 55 miles long. The charter for this road was secured several years ago and a considerable amount of surveying has been done.

POUGHKEEPSIE & MILLBROOK.—Chartered in New York to build a railway from Hibernia to Millbrook, 4 miles. Among the incorporators are John P. Wilson, Jas. L. Williams, Thos. Lawler and others.

GOSHEN LATERAL.—Pres., T. E. C. Hawks, Goshen, Ind., writes that this is substantially a belt line beginning at a point on the Lake Shore & Michigan Southern Ry. in Goshen, Ind., and running thence south to the banks of the Hydraulic Canal, and thence south and east to the tracks of the Cleveland, Cincinnati, Chicago & St. Louis Ry., a distance of 2½ miles. The surveys have been completed, but no work has yet been done.

LACKAWANNA, LAKE ERIE & HONESDALE.—Chartered in Pennsylvania to build a railway from Honesdale, Wayne Co., Pa., to a connection with the Delaware, Lackawanna & Western Ry., at or near Moscow, Lackawanna Co., Pa., a distance of 24 miles. Among the incorporators are: Thos. J. Hain, Honesdale, Pa., and Geo. B. Dimmick, of Scranton, Pa.

NIAGARA SHORE TERMINAL.—This company has issued notices to the people owning land along the river bank between Gratwick and La Salle, N. Y., that it intends to build along the river and to use a part of their land. This is the revival of an old scheme and the plan is to build a broad gage railway from Gratwick to Niagara Falls, eight miles. The officers of the company are: Pres., F. C. M. Lautz, and Secy., Benj. G. Long.

Southern.—Existing Roads.

LAUREL RIVER & HOT SPRINGS.—The contract for building this railway was let to L. H. Wheaton, C. E., formerly Chief Engineer of the Phillips & Rangely R. R., narrow gage, in Maine, on Sept. 3, 1892. The road will be 24 miles long and will run in a northeasterly direction from Hot Springs, N. C., through the Laurel River Valley. About half of the line will be mountain work; maximum grade 5% and maximum curve 30°. The track will be 24-in. gage. It is expected to begin tracklaying by Nov. 1 and to have the line completed by March 1, 1893. Pres., Jas. Wyman; Ch. Engr., H. M. Ramseur.

EMPIRE & DUBLIN.—This company has been reorganized and its name changed to the Oconee & Western R. R. Co. The following officers have been elected: Pres., A. E. Hatchfield, New York City; Vice-Pres., Claude Estes, Macon, Ga.; Secy. and Treas., W. A. Heath, Atlanta, Ga., and Gen. Man. and Supt., J. W. Hightower. It is stated that the new company will make several extensions of the line.

CHESAPEAKE & OHIO.—This company has completed plans for a new bridge over the Big Sandy River between West Virginia and Kentucky near Hampton City, Ky. The object is to do away with the long trestle approach on the Kentucky side. Land has been purchased for the approaches and to accommodate the change in roadbed necessary to reach the new structure.

CARABELLE, TALLAHASSEE & GEORGIA.—It is announced that work will probably be resumed on this railway about Dec. 1. This company is successor to the Augusta, Tallahassee & Gulf R. R. Co. and its proposed line is from Carabelle, Fla., via Sopchoppy and Tallahassee, Fla., to Thomasville, Ga., 100 miles. Gen. Man., A. Orr Symington, Carabelle, Fla.

HARRIMAN COAL & IRON.—Tracklaying on the line from Harriman to Brushy Mt., Tenn., 14 miles, began Oct. 10, and Gen. Man. Geo. W. Earley is reported as saying that the line would be completed this fall.

LOUISVILLE & NASHVILLE.—Work has been commenced on a branch about 20 miles long from Pineville, Ky., to the lands of the Log Mt. Coal & Coke Co. The line is to be completed by April, 1893.—There is a rumor that a 7-mile line will be built to the mines of the Virginia Coal & Iron Co.

CHESAPEAKE & OHIO.—The contract for the construction of the 10-mile branch up Loup Creek, in West Virginia, noted last week, was let in 2-mile sections, the following being the contractors: G. G. Gooch, J. C. Carpenter, W. A. Rinehart, Langhorne & Wright, and Montague & Tyler. The contract for masonry and bridges was let to Eggleston & Dennis.

EMPIRE & DUBLIN.—This company will be reorganized, and its name changed to the Oconee & Western Ry. Co., with general offices at Hawkinsville, Ga. The reorganization anticipates some further extensions of the line.

GENESIS & OBED RIVER.—Lina Beecher, President, writes to the "Manufacturers' Record" that his company is now building its road from Crossville to Johnson's Stand, Tenn., a distance of 15 miles, through the coking coal regions of the Cumberland Plateau, to make connection with the Nashville & Knoxville R. R.

LOUISVILLE TERMINAL.—The Louisville, Ky. "Courier Journal" states that three miles of this belt line at Louisville have been completed. This project, which has been talked of for some time, was revived last July, and its plan is to construct a railway to encircle the city from the river on the north to the river on the west, at a distance of from one to five miles from the city limits, and to cross all railways entering the city, except those crossing the river into Indiana. In addition to the belt line proper, branches will be built to factories on the outskirts of the city. The total length of the road will be 20 miles, of which 8 miles, now under construction, is expected to be completed this fall. The road will do both a freight and passenger business, the passenger cars being operated by the electric storage battery system. Pres., Geo. L. Danforth, Louisville, Ky.

Projects and Surveys.

MISSISSIPPI CENTRAL VALLEY.—Arrangements are reported completed for building this proposed railway from Rosedale, Miss., to Bogue Phalia, about 6½ miles. Pres., Chas. A. Scott, Rosedale, Miss.

ABBEVILLE SOUTHERN.—It is stated that H. B. Plant, of New York City, President of the Plant System, has offered to build the Abbeville Southern Railroad, mentioned in our last issue, provided the people along the route will donate right of way, a bonus of $1,000 per mile, and have surveys made. The proposition has been accepted. The road is projected from Abbeville to some point on the Alabama Midland R. R., and surveying will be commenced at once.

CHICKASAWHAY & JACKSON.—This company has been chartered to build a line of railway in Mississippi. The terminal points are given as the west bank of the Chickasawhay River, in Wayne Co., and the right of way of the New Orleans & Northwestern Ry., in Jones Co., Miss. Among the incorporators are: Frank S. Robinson, Moss Point, Miss.; and Edward W. Robinson, Buckatunna, Miss.

Northwest.—Existing Roads.

YANKTON, NORFOLK & SOUTHWESTERN.—Sealed proposals will be received by the Secretary of this company at Yankton, S. Dak., for the purchase or rental of a transfer boat, suitable for carrying the railway rolling stock of this railway. Proposals should be classified as follows: (1), Proposals to sell transfer boat; (2), proposals for taking contract to do entire transfer business of railway; (3), Proposals for rental of transfer boat. Requirements and specifications can be obtained from the Chf. Engr., Yankton, Norfolk & Southwestern Ry., Yankton, S. Dak.

ST. LOUIS, CHICAGO & ST. PAUL.—The engineers of this company have begun the final survey for the extension from Alton to East St. Louis, Ill.

Projects and Surveys.

ST. LOUIS, QUINCY & SIOUX CITY.—Rumors are in circulation that surveys are in progress on this old line between St. Louis, Mo., and Sioux City, Ia. The scheme is some years old, and although the company's organization is yet kept up, there is little life in the enterprise. Josiah Fogg, St. Louis, Mo., is the President.

Southwest.—Existing Roads.

NEW ORLEANS [illegible]. Charles H. Hammett, of Kansas City, Mo., and William D. Jenkins, of Natchez, Miss., have resigned as receivers of this company, and Judge Pardee, of the United States Circuit Court, has appointed Louis K. Hyde, of Titusville, Penn., to the receivership. Charles H. Hammett has been elected President of the company, and William D. Jenkins, Gen. Man. Judge Pardee also authorized the issuance of receivers' certificates with which to extend the road from Dayville, its present terminus, to Collins, La., where a connection will be formed with the Houston, Central Arkansas & Northern R. R., which improvement will be made at once.

HOUSTON BELT & MAGNOLIA PARK.—A 3-mile extension of this railway to Harrisburg, Tex., is said to have been decided upon.

Projects and Surveys.

GULF, NEWPORT & NORTHERN.—The contract to build 20 miles of this railway is reported let to S. C. Christopher, Victoria, Tex. The road is projected to run from Alligator Head, near Pass Caballo, on the coast, toward the interior of the state.

LITTLE ROCK BRIDGE & TERMINAL.—This company has been chartered in Illinois by B. F. Orr, New York City, and John M. Rose, W. A. Compton and F. W. Gibb, of Little Rock, Ark. It proposes to build a railway near Little Rock, Ark., where a connection can be made with the Memphis, Hot Springs & Pacific Ry., and then run north through Pulaski Co., to a point on the north bank of the Arkansas River, where a suitable connection can be made with the Little Rock & Memphis R. R. It also proposes to erect a toll-bridge across the Arkansas River at Little Rock.

GALVESTON & BEAUMONT.—The "Manufacturers' Record" says that Michael F. Lynch, of Fort Worth, Tex., will make a preliminary survey for this proposed road. A line will be run from Bolivar Point to Beaumont, Tex., thence to Shreveport, La. From Beaumont a return survey will be made to Smith's Point, at Redfish bar for a possible connection with the North Galveston R. R.

CORPUS CHRISTI & EAGLE PASS.—Press dispatches state that work will begin immediately upon this proposed railway from Larredo to Eagle Pass, Tex., along the northern bank of the river. The surveys have been completed.

MOODY & WACO.—The project to build a railway from Moody to Waco, Tex., is again being agitated by the citizens of Moody, Tex.

ARKANSAS MINERAL BELT.—This company, whose incorporation was noted in our issue of Oct. 6, has begun the surveys for its proposed line.

Rocky Mts. and Pacific.—Existing Roads.

GREAT NORTHERN.—About 42 miles of track have been laid from Snohomish, Wash., east to Granite Falls, on the west side of the mountains. About 2,000 men are now at work on this section of the line.

SOUTHERN PACIFIC.—It is stated that Pres. C. P. Huntington has ordered the proposed extension from a point south of San Louis Obispo, Cal., to Elwood, Cal., to be completed at once. A small force has been at work on the line for some time, but this is to be enlarged and the work pushed more vigorously. The work will be very heavy, there being no less than seven seven tunnels on the first 16 miles south of San Luis tunnels on the first 16 miles south of San Luis Obispo.

Projects and Surveys.

HELENA & DILLON.—According to the local papers there is some prospect that the old project of constructing a railway from Helena to Dillon, Mont., 140 miles will be revived. The line was surveyed some years ago.

BRITISH PACIFIC CONSTRUCTION CO.—This company has been chartered in British Columbia to build the Canada & Western Ry., previously noted.

ALTON CONSTRUCTION CO.—This company has been chartered in Colorado to construct railways. The Directors are: John G. Chandler, Jas. Adkins, H. G. Knapp and B. L. Crosby, all of St. Louis, Mo.

RIVERSIDE, SAN BERNARDINO & LOS ANGELES.—This company has been chartered in California to build a railway from Morongo Pass, northeast of San Bernardino, to San Bernardino, Colton, Riverside and Los Angeles. Among the incorporators are: D. S. Dorn and Samuel Miller, of San Francisco, Cal., and R. J. Davis, of Alamada, Cal.

ELECTRIC RAILWAYS.

CANANDAIGUA, N. Y.—An electric railway to the recently incorporated town of Manchester, six miles east, is projected.

LOCKPORT, N. Y.—An electric railway is to be built to the lakeside resort of Olcott.

PHILADELPHIA, PA.—The Council Committee on Railways has favorably recommended the ordinance for permission to allow the Fairmount Park & Haddington Passenger Ry. to lay tracks in the 34th Ward, and to use electric motors to be supplied from overhead wires, work to be begun within six months and completed in one year. Ordinances granting similar privileges to the Elmwood & Fairmount Park Passenger Ry. Co. in the 27th and 34th wards, and the Holmesburg, Tacony & Frankford Passenger Ry. have also been reported favorably.

BALTIMORE, MD.—The traction syndicate's plan for a boulevard and electric road between Baltimore and Washington will be enlarged, and the road extended to Philadelphia. The company has been incorporated in Maryland as the Washington & Baltimore Boulevard & Electric Ry. Co. The act requires that work on the road shall begin within six months, and be completed within 24 months after the passage of the act. It is said to be expected to run trains at the rate of 60 miles an hour. The fare from Baltimore to Washington will be 25 cents.—The Edmonson Ave., Cantonsville & Ellicott City Electric Ry. Co. has been granted permission to lay tracks in the western section of the city.—E. D. Smith & Co. have the contract for building the York Road electric line.

STAUNTON, VA.—The City Street Ry. Co., which has a franchise to operate its road by electricity, has awarded the contract to Randolph Stalnaker for the equipment of its road. Work is to begin by Nov. 1 and be completed by January.

ATLANTA, GA.—The Atlanta Traction Co. has elected officers as follows: Pres., James W. English; Vice-Pres., T. B. Paine; Supt. and Electrician, W. H. Reynolds, an engineer of Cincinnati, O.

MONTGOMERY, ALA.—The West End & Riverside Electric Street Ry. Co. is building a line four miles long, which requires half a mile of bridging and trestling and many expensive railway crossings. The electric equipment will be furnished by the Westinghouse Electric & Mfg. Co., of Pittsburg, Pa., and the 16-ft. cars will be built by the J. W. Brill Co., of Philadelphia, Pa. The cost will be $100,000 independent of the power station and car barns. Another electric suburban line is also being built.

CHICAGO, ILL.—The South Chicago City Ry. Co. has applied for power to build an electric railway on Stoney Island Ave.

EAST CHICAGO, ILL.—The Whiting, Hammond & East Chicago Ry. Co. has applied for a franchise.

MARSHALLTOWN, IA.—A line three miles long with a power plant of 500-HP. capacity is being built. Cons. Engr., W. H. Bryan, of St. Louis, Mo.

ST. LOUIS, MO.—The construction of the Cass Ave. electric railway is soon to be commenced, all preliminary work having been completed. The line will be about 40 miles long and extend from Fourth and Walnut Sts. to the fair grounds, with extensions through the entire northwestern part of the city. There will be three 800-HP. generators furnished by the General Electric Co., and each car will carry two 25-HP. motors. The three 1,000-HP. engines are yet to be purchased. Mr. Winthrop Bartlett, M. E., of St. Louis, is the engineer.

KANSAS CITY, KAN.—The electric plant for the elevated railway has been completed.

ATCHISON, KAN.—The Atchison Electric Motor & Street Ry. Co. has been incorporated by A. J. Harwi, J. C. Fox, W. F. Dolan, J. S. Henry and A. W. Simpson, all of Atchison, with a capital stock of $500,000. It is proposed to build a railway beginning at the intersection of 2nd and Commercial Sts., to the corporate limits and to suburban points, across the Missouri River into Buchanan Co., Missouri. The road will then run five miles southeast to Sugar Lake. The estimated length of the proposed line is 30 miles.

SOUTH DENVER, COLO.—The Denver Tramway Co. has made the citizens of South Denver a proposition to construct and operate an electric line on Pearl St. from Almeda Ave. south to Jewell Ave. The company wants a subsidy of $10,000 to construct the line.

TORONTO, ONT.—Work on the East Toronto section of the Toronto & Scarboro' Electric Ry. will be commenced soon. It is intended to complete this section during the present year.

COTE ST. ANTOINE, QUE.—The franchise for building and operating an electric railway has been granted to the Montreal Street Ry. Co. Two miles will be built this year and two miles next year.

ELEVATED RAILWAYS.

BROOKLYN, N. Y.—The Brooklyn Elevated Ry. Co. has awarded the contract for the extension of the main line from Fulton St. and Schenck Ave. to Jamaica Ave. to the Edge Moor Bridge Works, of Wilmington, Del., and the southern extension from 38th St. to Third Ave. and thence to 65th St. and southward to Fort Hamilton, was awarded to Cofrode & Saylor, iron manufacturers of Pottstown, Pa.

PORTLAND, ORE.—The company which has the contract for the construction of the elevated railway on Hawthorne Ave., from East Water St., to Union Ave., has commenced work. The East Side Ry. Co. has a roadway for its double track in the middle of the avenue, and the contractor will only build on each side of this portion. From Union Ave. eastward to E. 20th St., a considerable part of the grading has already been done.

QUEBEC, QUE.—A company has been organized and has applied to the corporation for permission to build an elevated electric street railway.

HORSE AND MOTOR RAILWAYS.

MCKEESPORT, PA.—Citizens' Passenger Ry. Co.; $30,000 capital stock, with $6,000 paid up; Pres., James S. Kuhn.

WASHINGTON, D. C.—The District of Columbia Suburban Ry. Co. proposes to build a line to Brandensburg; Pres., Col. Gilbert Norges; Vice-Pres. and Supt., Geo. P. Davis.

SPARTANBURG, S. C.—The Spartanburg, Clifton & Glendale Ry. Co. will extend its dummy line to Whitney and Glendale as soon as its surveys now in progress are completed. Pres., A. H. Leftwich; Chf. Engr., Geo. E. Ladoban. Contractors can apply for profiles and estimates.

MOBILE, ALA.—The franchises and plant of six lines of the Mobile Street Ry. Co., will be sold at an tion Nov. 14, by the Fidelity Trust & Safety Vault Co.

HOUSTON, TEX.—The Houston City Street Ry. Co. has been incorporated by H. T. McGregor, T. W. House and O. M. Carter, with a capital sto k of $400,000.

HIGHWAYS.

NEW JERSEY.—Chief Engineer E. W. Harrison, of the Hudson County public road, has submitted to the Board of Freeholders his preliminary statement of quantities for grading, regulating and improving the boulevard between the Morris Canal and the Newark & New York Ry. cut in Jersey City. The whole estimate amounts to $28,000. The Freeholders will advertise for proposals. Much of the line runs through market gardens, where the work can be prosecuted during the winter.—The Board of Freeholders of Middlesex Co. have authorized the expenditure of $60,000 in the improvement of the public roads. Contracts have been awarded and the work on the same begun. All the new roads must be completed by Dec. 1, at which time there will have been laid at least 10 miles of macadamized road. Two-thirds of the expense will be borne by the taxpayers of the county, and the rest by the state.

MISSOURI.—Bids for the grading of the Martin Bridge and Hickman Mills road will be received until Oct. 31, by T. J. O'Flaherty, County Surveyor, Kansas City, Mo. Profiles and specifications can be seen at this office.

BRIDGES, TUNNELS AND CANALS.

LITTLE ROCK, ARK.—The Little Rock Bridge Co. has been chartered to build a bridge across the Arkansas River. Among the incorporators are W. H. Ragland, H. C. Bateman and others.

WACO, TEX.—A project is on foot to build a bridge across the Brazos River at this place.

WATER-WORKS.

New England.

WOLFBORO JUNCTION, N. H.—The Committee on Water-Works estimate that works could be built for $25,000. A precinct meeting will be held Dec. 10, at which the matter will be discussed.

PITTSFORD, VT.—Surveys for the proposed works of the recently organized Pittsford Aqueduct Co. are being made by J. W. Burke, Rutland. A gravity supply with a reservoir is proposed. It is said that $20,000 of stock subscriptions have been secured.

Middle.

MONTGOMERY, N. Y.—Works are again talked of.

TROY, N. Y.—It is reported that engineers are to be engaged by the Water Commissioners to make surveys for an additional supply.

IRVINGTON, N. J.—The Village Trustees have renewed their request for a water supply from the Newark Works.

ERIE, PA.—A 5-ft. steel intake, extending 3,500 ft. from the shore to 35 ft. of water, is talked of.

ERIE, PA.—Oct. 12 the city closed a contract for a 12,000,000-gallon Worthington horizontal high duty pumping engine to work against a head of 240 ft.

PHILADELPHIA, PA.—Nov. 7 application for the incorporation of the Perkiomen Water Storage, Transportation & Supply Co. will be made by C. J. and Joseph Young, L. D. Buckley, Wm. Magoffin and A. Victor Lamb. It is stated that the object or power of the company, as sought, will be the impounding, storage, transportation and utilization of water in the Perkiomen Creek, and the erection of reservoirs or impounding dams; also the erection of pumphouses and machinery, and the laying of pipes and conduits to supply water to any point in the state.

PHILADELPHIA, PA.—The city proposes to let the contract for a considerable part of the work on the new reservoir in the 28th Ward, to Filbert. Porter & Co., for $795,514, with the privilege of ordering the remainder of the work done for a total cost of $1,150,501. John B. Reilly bid $1,049,500 for the work complete, and has obtained a temporary injunction to prevent the award of the contract as proposed.

SALTSBURG, PA.—In November the people will vote on issuing $12,000 of bonds for works.

CUMBERLAND, MD.—The Water Commissioners talk of buying a new boiler.

Southern.

TARBORO, N. C.—The Tarboro Water-Works Co. has been incorporated to maintain works here; $50,000.

KEY WEST, FLA.—The people have voted in favor of works, but no plans have been adopted. The "Democrat" is opposed to granting a franchise, preferring city ownership.

CLEVELAND, TENN.—A vote on building works will be taken.

North Central.

GREENVILLE, O.—J. W. Hill, Cincinnati, has been engaged as engineer of the new works.

SANDUSKY, O.—The officials are discussing a better supply, to be obtained by filtering the present supply or adopting a new source.

HOWELL, MICH.—Works have been talked of since a recent fire.

CHESTER, ILL.—Consulting Engineer W. H. Bryan, St. Louis, Mo., has recently completed plans for a system of water supply. Water may be pumped from the Mississippi River to settling basin, and filters may be used. The town is on a 350-ft. elevation; estimated cost, $100,000.

COLLINSVILLE, ILL.—The awarding of the contract for new works has been postponed.

DECATUR, ILL.—The contract for a Warren filter has been awarded to the Cumberland Mfg. Co., Boston, for $32,500. The Morrison-Allen Co. bid $46,950 for putting in a Jewell filter, and the New York Filter Co. offered to construct a plant for $51,700. It is said that the plant will have a capacity of 3,000,000 gallons.

FAIRBURY, ILL.—Bids for $15,000 5% water main extension bonds are wanted until Oct. 29. S. M. Barnes, Prest. Bd. Trustees.

VENICE, ILL.—No bids were received for the purchase of the village works.

JANESVILLE, WIS.—The Council has ordered the company to Ly 8,000 ft. of new mains.

Northwestern.

WHAT CHEER, IA.—This place has voted to put in works, it is reported.

SENECA, KAN.—It is stated that this place has decided to have works.

CEDAR RAPIDS, NEB.—A recent fire has caused water-works talk.

BODMIN, MONT.—Gravity works are proposed.

Southwestern.

COLUMBIA, MO.—Surveys for works are being made by Engr. Hiram Phillips, St. Louis.

HOLDEN, MO.—Plans have been completed by Consulting Engr. W. H. Bryan, St. Louis, for enlarging and improving the works.

ST. CHARLES, MO.—The St. Charles Water & Hearing Co. talks of extending its intake pipe further into the river, extending its mains and building a large tank or reservoir, all at an estimated cost of $50,000.

JEFFERSON, TEX.—Address Mayor L. S. Scheuter regarding proposed works.

OAK CLIFF, TEX.—F. N. Oliver can give information regarding proposed works and bonds to pay for the same.

CREEDE, COLO.—Bids for $25,000 8% 10-15-year water bonds are wanted until Nov. 1. E. W. Hurlburt, Mayor; Jas. P. Owen, Treas.

CRIPPLE CREEK, COLO.—The Fremont Town Board has granted a franchise to J. A. Jones, representing the Michigan Pipe Co., Bay City, Mich. The supply will be from springs near or on Mt. Pisgah.

Pacific.

PORT TOWNSEND, WASH.—The Mount Olympus Water Co. again proposes to introduce a new supply. Engr. R. E. Andrews, Seattle, has made new surveys, shortening the supply main six miles over that originally proposed. The present scheme includes a 12-in. main twelve miles long to a reservoir, and a 14-in. main four miles long, from the reservoir to the city. An offer has been received for about $200,000 6%, 20 and 30-year bonds.

LOS ANGELES, CAL.—Bids are wanted until Nov. 7 for a Pelton water wheel and also for a turbine wheel. Address Wm. Mulholland, Supt. City Water Co., for specifications.

WOODLAND, CAL.—A contract for a new pump, mains, Schenck hydrants and other improvements has been awarded to the Dow Steam Pump Works for $28,775.

ARTESIAN WELLS.

GLOUCESTER CITY, N. J.—Test wells are being sunk with a view of determining whether a supply can be obtained from wells.

ASHLAND, PA.—The borough officials are thinking of boring a well to increase the water supply.

BIG RAPIDS, MICH.—Engr. W. R. Coats, Kalamazoo, has been engaged to draw specifications for wells to increase the water supply.

ABERDEEN, S. DAK.—Bids for a 6-in. well will probably be wanted. Address the city engineer.

IRRIGATION.

NEW COMPANIES.—Riverside Canal Co., Ottumwa, Ia.; $300,000. Palouse Irrigating Ditch Co., Washington; $500,000; to dig an 80-mile ditch from the junction of Palouse River and Crow Creek. Starr Irrigation Co. incorporated at Provo, Utah; $300,000; Pres., Branch Young; Secy., S. A. Coray; Engr., W. B. Searle. Armstrong Land & Water Co., Salt Lake City, Utah; $500,000; Francis Armstrong, A. E. Hyde and others.

SEWERS.

MALDEN, MASS.—Geo. A. Wetherbee, Cy. Engr., has submitted a report on a sewerage system for the city in conjunction with the metropolitan system of Boston. He finds that the daily consumption of water is 60 gallons per capita per day, and the population of the city a little over 30,000. The city is divided into 13 sections, and the total length of the entire system as proposed is 339,873 ft., and the cost $599,050, to which he adds $44,930 for a pumping plant at Linden, $53,372 for the Linden trunk sewer, and $26,932 for pumping house expenses, electric motor, etc. The report advises the employment of resident labor by the day, and of competent inspectors in order to insure satisfactory work.

MILFORD, MASS.—The Board of Health has decided to employ an engineer to devise means to remedy the Charles River nuisances.

WAKEFIELD, MASS.—Louis Hawes, Boston, has prepared a report on a sewerage system for this town. The town is divided by a ridge into two districts, and the report recommends that the first of these districts, comprising Greenwood and Boynton villages, be made a portion of the metropolitan system; also that the sewage of the other district be taken to the area near the town farm and there disposed of by intermittent filtration. The estimated cost has not yet been made public.

CHAUTAUQUA, N. Y.—The contract for a sewer system has been awarded to W. J. Dunn, Pittsburg, Pa., at $9,000, the work to be completed in 40 days.

BRIDGETON, N. J.—The Joint Committee on Sewers, Ed. M. Fithian, Chn., has recommended that bonds be issued for $100,000 for the construction of a sewerage system.

MEADVILLE, PA.—Samuel M. Gray, Providence, R. I., has been in the city and has made a proposition to the Councils for preparing surveys, specifications and estimates for a complete sewerage system for the city. It is thought that the Councils will accept the offer.

PHILADELPHIA, PA.—The Director of Public Works estimates that $1,611,500 will be required to construct the sewers absolutely necessary next year, and that $600,000 of this should be provided immediately. The chairman was instructed to prepare an ordinance to create a loan of $1,000,000 for main sewers.

WILMERDING, PA.—About $12,000 will be expended in sewers, and we are informed that the work may be done this autumn.

WASHINGTON, D. C.—The lowest bid for sewers in certain streets was that of M. F. Talty, $12,808.

CHARLESTON, S. C.—An ordinance has been referred to the Committee on Sewerage ordering the preparation of surveys and specifications for a complete system of sewerage for the city, and authorizing the expenditure of $3,000 to pay for the same.

SELMA, ALA.—Julian Smith, Cy. Engr., is investigating the subject of a sewerage system.

CLEVELAND, O.—The Board of Control will receive bids until Oct. 26 for sewer and water connections in six streets.

CLYDE, O.—Bids will be received until Oct. 31 for a vitrified salt glazed pipe sewer. A. G. Winnie, Cy. Clk.

MUNCIE, IND.—The City Council will receive bids until Oct. 24 for an 8 to 18-in. vitrified salt glazed pipe sewer.

MONMOUTH, ILL.—The Council has passed an ordinance for a sewer system in East Broadway.

IRON RIVER, WIS.—The Town Board is considering the advisability of putting in a system of sewers.

OMAHA, NEB.—The Board of Public Works will receive bids until Oct. 28 for sewers in three districts.

DENVER, COLO.—The lowest bid for the Downing Ave. sewer was that of J. B. Hendry, $10,172.

FRESNO, CAL.—It is estimated that it will cost $75,000 to complete the sewer system, including flushing connections.

LOS ANGELES, CAL.—The City Clerk will receive bids until Oct. 31 for cement for the outfall sewer, as follows: 2,900 bbls. to be delivered at Park Station, and 9,100 bbls. to be delivered in the town of Inglewood. Bids will soon be asked for the construction of sections 1 to 9 of the outfall sewer.

POMONA, CAL.—We are informed by W. H. Sanders, Cy. Engr., that a public meeting will be held to discuss the proposed sewer system.

CORVALLIS, ORE.—J. G. Kelly has been appointed engineer for the construction of the proposed water-works and sewerage system. He will at once prepare estimates of the cost of the two improvements.

STREETS.

BOSTON, MASS.—The Street Commissioners have appropriated $50,000 to widen Water St. Hearings have been given on the proposed widening of other streets, but no definite action has been taken. The commissioners will visit New York, Brooklyn and other cities to inspect the systems there adopted of laying and constructing streets and sewers.

BROOKLYN, N. Y.—The Commissioner of City Works will receive bids until Oct. 28 for repaving in five streets with granite blocks.

BUFFALO, N. Y.—The Buffalo Paving Co. has been awarded the contract for paving Tryon Place, at $31,000. Puerner Ave. is to be paved with German rock asphalt at a cost of $19,000.

FLUSHING, N. Y.—The Village Clerk will receive bids until Nov. 1 for $36,000 of 4% street improvement bonds.

SYRACUSE, N. Y.—The following bids were received for paving Hawley St., between Howard and Townsend Sts., with asphalt: D. S. Howe, $22,286; J. M. Mack & Co., $24,557; W. H. Gallup, $24,389; Warren-Scharf Asphalt Paving Co., $26,032.

HOBOKEN, N. J.—The City Council will receive bids until Oct. 26 for the improvement of several streets, including repaving in five with Belgian blocks.

NEWARK, N. J.—The Township Committee of Kearny will receive bids until Oct. 25 for grading, curbing, etc., Chestnut St. David Young, Township Surveyor. The Board of Works has voted to advertise for the paving of Polk St., to cost about $10,000.

ALLEGHENY, PA.—The contract for paving Iten St. with Ligonier blocks has been awarded to Sloan & McIlwain, at $39,725.

WILMERDING, PA.—We are informed by Dr. Geo. L. Beswick, Chn. Finance Com., that the borough proposes to spend about $60,000 in paving, though probably no work will be done before spring.

NORFOLK, VA.—The following estimates prepared by the City Engineer have been referred to the Street Committee: Plume St., paving, curbing, etc., $22,452; Granby St., $47,295; Princess Ann Ave., $22,100.

GREENVILLE, S. C.—The City Council has voted to pave Main St. with macadam, at an estimated cost of $15,000. The street will be excavated to a depth of 12 to 14 ins., then three layers of stone will be laid, and this covered with sand. The City Engineer has been instructed to prepare estimates for the paving of other streets.

NORWALK, O.—The City Clerk will receive bids until Nov. 11 for the construction of 15,613 sq. ft. of stone or brick sidewalk.

CINCINNATI, O.—The contract for the improvement of Eighth St. around the viaduct has been awarded to Henkle & Sullivan, at $40,718.

JOLIET, ILL.—The City Clerk will receive bids until Oct. 24 for grading and paving in two streets.

QUINCY, ILL.—The Board of Public Works will receive bids until Nov. 3 for paving Main St. with brick.

OMAHA, NEB.—The Board of Public Works will receive bids until Oct. 28 for paving six streets with asphalt, granite, sandstone, or brick; also for constructing sandstone curb in the same.

PORTLAND, ORE.—The City Council has voted to advertise for bids for the paving of Morrison St. with Trinidad Lake asphalt.

ELECTRICAL.

BATAVIA, N. Y.—At a special meeting Oct. 12, the Board of Aldermen decided to advertise for an electric light plant, for both public and private purposes.

KITTANNING, PA.—A local company has offered to put in 20 arc lights of 2,000 c. p. each at $90 per light per year.

RICHMOND, VA.—The City Council is considering an ordinance to appropriate $125,000 for a municipal plant.

GALLATIN, TENN.—The city is reported as wanting an electric light plant. J. S. Vinson, Cy. Recorder.

CHESTER, ILL.—Preliminary plans for an electric light plant have been completed by W. H. Bryan, M.

E., St. Louis, Mo. There will be 1,000 incandescent and 50 arc lights at the start.

KANSAS CITY, KAN.—The proposition of the Fort Wayne Electric Co. to construct a plant for the city includes the erection of 19 towers from 100 to 125 ft. in height, each carrying 10,000 c. p. of light. The entire cost of the plant is placed at $100,000.

NEW COMPANIES.—Hearne Electric Light Co., Hearne, Tex.; $10,000; Peter L. Brady, Wm. Brady, Butte General Electric Co., Butte, Mont.; $000,000; H. M. Byllesby and H. C. Lewis, St. Paul, Minn., and J. R. Wharton, Butte. Shoshone Falls Electric Power & Irrigation Co., Chicago, Ill.; $25,000,000; N. W. Perry, H. C. Baker, J. B. Schmatz, Fairbury Electric Light, Heat & Power Co., Fairbury, Ill.; $12,000; H. A. Foster, N. J. Foster, C. E. Grandy. Toulon Light & Power Co., Toulon, Ill.; $10,000; M. A. Fuller, V. G. Fuller. Columbian Electric Gas Co., Chicago, Ill.; $500,000; J. H. Carruthers, W. E. Briggs, John Irvine. Bear Electric Mfg. Co., Chicago, Ill.; $500,000; S. E. Moore, J. H. Carruthers, John Irvine.

CONTRACT PRICES.

TRENCHING AND CONDUITS.—Syracuse, N. Y.—The following bids have been received for laying about 10 miles of 30-in. water conduit, from Skaneateles Lake to the city of Syracuse:

Section 1.

John Cornwell, Jr., New York	$89,673
Chas. H. Raynor, Syracuse	95,707
Everson & Liddle, Providence, R. I.	123,800
Jos. A. Flynn, New York	145,440
John M. Mack, Syracuse	174,904
McArthur Bros., Chicago, Ill.	207,632
Troy Public Works Co., Troy	272,825

Section 2.

Jos. A. Flynn, New York	$84,946
John M. Mack, Syracuse	85,621
Clinton Beckwith, Herkimer	87,103
Chas. H. Raynor, Syracuse	88,464
John Cornwell, Jr., New York	90,933
Troy Public Works Co., Troy	90,993
Richard Dawson, Syracuse	104,308
Everson & Liddle, Providence, R. I.	100,465
McArthur Bros., Chicago, Ill.	115,581

Section 3.

Clinton Beckwith, Herkimer	$50,184
Chas. H. Raynor, Syracuse	62,281
Jos. A. Flynn, New York	63,002
Troy Public Works Co., Troy	75,774
John M. Mack, Syracuse	76,101
Everson & Liddle, Providence, R. I.	82,918
McArthur Bros., Chicago, Ill.	83,349

Section 4.

Francis Curnan, Rhinebeck	$57,442
Clinton Beckwith, Herkimer	58,079
Chas. H. Raynor, Syracuse	66,896
Jos. A. Flynn, New York	69,449
John M. Mack, Syracuse	69,603
Troy Public Works Co., Troy	72,112
Everson & Liddle, Providence, R. I.	79,165
Wm. Patrick, Phoenix	90,501
McArthur Bros., Chicago, Ill.	90,577

The contract for each section was awarded to the lowest bidder. The itemized price and approximate work to be done, are as follows:

Items.	Sec. 1. Quan.	Price.	Sec. 2. Quan.	Price.	Sec. 3. Quan.	Price.	Sec. 4. Quan.	Price.
		$		$		$		$
Chopping and clearing, sq. rods	40	2.00	2,240	.30	610	1.00	180	.10
Grubbing and clearing, sq. rods	40	2.00	1,000	.70	100	1.50	50	.75
Bailing and draining, section	1	800.00	1	500.00	1	750.00	1	500.00
Testing pipes under pressure, section	1	400.00	1	2,500.00	1	500.00	1	1,500.00
Excavation of earth, cu. yds.	98,000	.22	52,000	.40	14,000	.46	50,000	.33
Excav. of rock requiring blasting, cu. yds.	5,000	1.00	7,000	1.60	2,500	2.75	2,000	2.50
Exc'v. of hardpan req'ing blasting, cu. yds.	2,500	.50	3,500	.95	1,000	1.25	1,500	1.00
Embankment, cu. yds.	2,000	.20	6,000	.30	8,000	.30	2,000	.37
Loose stone or riprap, cu. yds.	400	2.00	300	1.50	600	1.50	300	1.00
Gravel lining, cu. yds.	100	1.50	200	1.00	300	.50	200	.60
Slope wall, cu. yds.	100	4.00	150	4.00	200	3.50	100	2.50
Box culvert masonry and cement, cu. yds.	250	7.00	200	5.00	200	6.00	180	5.00
Retaining walls in cement, cu. yds	100	4.00	200	5.50	400	6.00	100	5.00
Retaining walls dry, cu. yds	100	2.00	2,000	4.50	300	4.50	100	4.00
Rubble masonry in cement, cu. yds.	150	4.50	200	6.50	250	6.00	180	6.00
Cut stone coping in cement, cu. yds.	15	20.00	20	25.00	30	12.00	20	10.00
Dimension cut stone, cu. yds	4	30.00	6	25.00	8	12.00	6	10.00
Brick masonry in cement, cu. yds	100	13.00	150	12.00	180	10.00	100	8.00
Concrete masonry, cu. yds.	100	5.00	100	5.00	100	6.00	100	6.00
Broken range face work, sq. yds	50	.50	60	3.00	100	2.00	100	5.00
Stone paving, sq. yds	400	3.50	400	1.00	1,400	1.50	400	1.50
Pipe hauled and distributed, tons	3,830	1.00	4,390	1.00	3,777	1.00	5,580	1.00
Pipe unloaded, temporarily deposited, tons	1,030	.40	1,000	1.00	1,000	.25	1,000	1.00
Laying 30 in. pipe, specials & fixtures, lin. ft.	26,850	1.75	26,200	.75	21,400	.40	30,000	.60
" 10 " " " " " "	170	.35	50	.50	150	.30	50	.40
" 8 " " " " " "	50	.30	150	.50	50	.21	50	.36
" 6 " " " " " "	50	.25	50	.50	60	.15	80	.32
Furnishing and laying 4 in. tile drain, lin. ft.	700	.35	1,200	.25	3,000	.10	1,500	.10
White oak timber and plank in work, F. B. M.	2,000	60.00	2,000	60.00	9,000	50.00	2,000	50.00
White pine timber and plank in work, F. B. M.	3,000	50 00	4 000	50.00	5,000	40.00	3,000	50.00
Hard wood timber and plank in work, F. B. M.	3,000	60.00	1,000	50.00	4,000	40.00	1,000	50.00
Hemlock timber and plank in work, F. B. M.	3,000	20.00	3,000	25.00	10,000	25.00	9,000	18.00
Wrought iron in work, lbs.	1,500	.04	1,500	.05	1,800	.08	1,000	.05
Cast iron in work, lbs	1,000	.03	1,000	.05	1,000	.06	1,000	.025
Spikes and nails in work, lbs.	200	.05	300	.05	800	.05	400	.08
Tin roofing, sq. ft.	800	.12	1,200	.12	1,500	.07	1,500	.06
Painting, sq. yds	100	.25	150	.50	100	.10	100	.03

SEWERS.—Canton, Ill.—We are informed by W. G. Harte, Cy. Engr., that a contract has been awarded to Chas. Overrocker, Quincy, at about $13,000, the prices being as follows: 42-in. double ring brick sewer, average cut, 8 ft., $3.47 per lin. ft.; 30-in. single ring, cut 7 ft. 2 ins., $2.00; 24-in., cut 9 ft. 9 ins., $2.07; 24-in., cut 6 ft. 3 ins., $1.97; 18-in. pipe, cut 7 ft. 5 ins., $1.55; wells for sewers, 3 to 6 ft. in diameter, $3.45 to $4.10 per foot depth.

Austin, Minn.—The contract for the extension of the sewer system has been awarded to Jas. A. Trane, La Crosse, at the following prices: 18 or 15-in. pipe sewer, $1.15 or $1.08 per lin. ft.; 9-in., 81 cts.; 8-in., 78 cts.; manholes, $40 each; lampholes, $8; flush tanks, $50.

STREET WORK.—Pittsburg, Pa.—About 400 bids were received Oct. 8 for street improvements, including nearly five miles of paving and ten miles of sewer. The bids were considered quite low, and were generally close, in one case there being a difference of but $1 on a contract aggregating nearly $20,000. The lowest bid for paving with block stone was $2.40 per sq. yd., and for asphalt, $2.50.

Kansas City, Mo.—The contract for paving Tenth St with asphalt has been awarded to the Barber Asphalt Paving Co., at $2.50 per sq. yd. The specifications call for 2 ins. of asphalt on 4 ins. of concrete, and the total cost will be about $37,000. The contract for paving Fifth St. was awarded to the same company at $2.65 per sq. yd. for 2 ins. of asphalt on 6 ins. of concrete. A contract for paving with vitrified brick was awarded to C. L. Powell at $1.73¾ per sq. yd.

DREDGING.—Galveston, Tex.—The only bid received by Maj. Chas. J. Allen for dredging the ship canal in the bay was as follows: Rittenhouse-Moore Dredging Co., Mobile, Ala., 230,000 cu. yds. dredging, 23 cts. per cu. yd.; 6,000 cu. yds. excavating and sloping, 25 cts. per cu. yd.; 2,000 lin. ft. revetment, 10 cts. per lin. ft.

LEVEE WORK.—Memphis, Tenn.—The lowest bids for 26 contracts, aggregating 2,320,000 cu. yds., for levee work for the Tensas and Yazoo levees, ranged from 14.74 to 22 cts. per cu. yd., with one contract each at 24 and 34 cts.

Alexandria, La.—Contracts for levee work have been awarded by the Red River, Atchafalaya & Bayou Boeuf Levee Board, at 17.5 to 19.95 cts. per cu. yd.

MISCELLANEOUS.

SUPPLIES FOR THE NAVY YARD.—Washington, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Dept., until Nov. 10, for naval supplies including the following: Electric overhead traveling crane, 83,300 lbs. support for same, 500 ft. steel rails, profiling machine, automatic gear-cutting machine, universal milling machine, boring and drilling machines, slotting machines, shaping machines, etc. Edwin Stewart, Paymaster-General, U. S. N.

FILLING.—Portland, Ore.—The Northern Pacific Termina! Co. will receive bids until Nov. 3 for 300,000 cu. yds. of filling.

MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Pittsburg Locomotive Works, Pittsburg, Pa., have orders for 12 mogul freight engines, 12 ten-wheel engines and 3 switch engines for the Duluth, Mesaba & Northern; they have also completed 3 passenger engines for the St. Louis, Vandalia & Terre Haute. The Baldwin Locomotive Works, Philadelphia, Pa., have an order for a ten-wheel compound engine on the Vauclain four-cylinder system, with cylinders 13½ × 24 ins. and 23 × 24 ins. for the Delaware, Lackawanna & Western. The Brooks Locomotive Works, Dunkirk, N. Y., have built a four-cylinder compound engine, with tandem cylinders, for the Great Northern; they have completed 50 freight engines and are building 25 more for the same road. The Schenectady Locomotive Works, Schenectady, N. Y., have delivered six ten-wheel engines, with cylinders 19 × 24 ins., driving wheels 5 ft. 10 ins. diameter, and weighing 160,000 lbs., to the Chicago & Alton; the works have completed a new foundry building 387 × 100 ft., two stories high; they employ about 1,875 men, and turn out nearly 30 engines a month.

CARS.—The Michigan Peninsular Car Co., Detroit, is building 1,000 freight cars to be leased by the Ohio Southern. The St. Charles Car Co., St. Charles, Mo., has an order for 20 passenger cars and 10 chair cars for the Missouri Pacific. The Ohio Falls Car Mfg. Co., Clarksville, Ind., $1,200,000, has been incorporated by J. L. Smyser, D. B. Pratt, J. D. Stewart and S. C. Taggart. The Drexel Railway Supply Co., of Chicago, is manufacturing the car vestibules patented by J. W. Barr, Superintendent of Motive Power of the Chicago, Milwaukee & St. Paul.

MORTAR CARRIAGES.—The Builders' Iron Foundry, Providence, R. I., has recently shipped for test at Sandy Hook the first of the eight 12-in. mortar carriages for which the firm has a contract from the U. S. Government. These carriages are large and powerful pieces of mechanism and are to be used for coast defense. The total weight of each is about 42 tons.

ELECTRIC ELEVATORS.—The C. & C. Electric Motor Co., New York, has an order for two 110-HP. generators to furnish current for the electric elevators in the Administration Building at the World's Columbian Exposition.

STEAM HEATING VALVE.—A special throttle valve for controlling the steam supply from the locomotive to the train pipe of the steam heating system has been recently brought out by the Consolidated Car Heating Co. It is somewhat similar to the throttle valve made by the Westinghouse Air Brake Co. for controlling the steam supply to the air pump, but is made for 1-in. pipe instead of ¾-in. It can be placed either horizontally or vertically and a connection to the dry pipe can be made by a bushing independent of the valve. The company has also brought out a dust guard for the Sewall steam coupler and will send samples to any railway on application.

THE WEIR FROG CO., of Cincinnati, O., has arranged with Yeats & Bigson, civil and consulting engineers, to represent it in Chicago and vicinity.

THE ILLINOIS ENGINEERING & CONSTRUCTION CO., 239 La Salle St., Chicago, has been incorporated to carry on an engineering and contracting business in all their branches. This company will also act as the general western agents for the Duval Metallic Packing, manufactured by Thornton N. Motley & Co., of New York. Mr. J. C. Slocum, formerly mechanical engineer of the World's Columbian Exposition, is the engineer and manager.

THE KING BRIDGE CO., Cleveland, O., has under way a number of railway and highway bridges, together with considerable structural metal work for buildings, among which are the new trainshed for the Illinois Central R. R., in connection with its new terminal station at Chicago; three iron buildings for the Brown-Bonnell Iron Co., Youngstown, O.; and one for the American Wire Nail Co., Anderson, Ind.

THE STUPP BROS. BRIDGE & IRON CO., of St. Louis, Mo., is furnishing the material for a 100-ft. span in Franklin Co., Mo.; several spans in Kansas and Iowa, and for 90-ft. and 70-ft. spans in Mercer and Monroe Cos., Ill. They have also recently completed the iron work for a 210-ft. draw span for the Jacksonville, Tampa & Key West Ry.

ROAD ROLLERS.—The Pope reversible road roller is being used in over 40 cities in the South and West. Among recent sales are the following: Three 7-ton rollers to Chicago contractors; price, $107 per ton. Covington, Ky., Petersburg, Va., J. G. Bear, Kansas City, Mo.; Key West, Fla., and Water Co., Ia. The price of the Pope 3½-ton county supervisor roller is $880. Mr. R. C. Pope is the manufacturer, 806 Chamber of Commerce Building, Chicago.

U. S. CARTTER & CO., of St. Louis, Mo., have been awarded the contract for building all the bridges, trestles, signal towers, and doing all masonry work, etc., on the new cut-off of the Wabash R. R., to extend from Montpelier, O., to Hammond, Ind. They are also building bridges in Florida, Ohio, Indiana, Tennessee and Missouri.

PUMPING ENGINES.—The firm of Henry R. Worthington, New York, N. Y., has established a branch office at 1762 Larimer St., Denver, Colo., where a full line of the various types of pumps made by the firm will be carried in stock. This office will also look after the water-works pumping machinery in that territory. The city of Erie, Pa., has awarded a contract to this firm for a horizontal high-duty pumping engine of 12,000,000 gallons daily capacity, against a head of 280 ft. H. B. Merrill, 36 Liberty St., New York, N. Y., who has recently completed the pumping plants at Summit and Woodbury, N. J., Holmesburg, Pa., Cambridge, Tarrytown, Mamaroneck and East New York, N. Y., and Vineyard Haven, Mass., and sewerage plant for East Orange, N. J., has been awarded the contract for the pumping plant for the Orange, N. J., sewerage system, which consists of two Worthington pumping engines, each of 1,500,000 gallons daily capacity. Mr. Merrill also supplied the above named plants with Worthington machinery.

The Worthington company has also contracts for a high duty engine of 8,000,000 gallons capacity for the Houston Water Co., Houston, tex.; and has completed the first of four horizontal high duty engines of 12,500,000 gallons capacity for the World's Columbian Exposition, a compound condensing engine of 10,000,000 gallons capacity for Bridgeport, Conn., and three engines of $500,000, 1,000,000 and 2,000,000 gallons capacity for the water-works at New Rochelle, N. Y.

NEW COMPANIES.—Nuttall Railway Supply Co., Chicago, Ill.; $25,000; Edward H. Harrison, P. H. Carey and E. A. Graatzinger. Pacific Marine Railway & Ways Co., San Francisco, Cal.; $50,000; to build marine railways, docks, etc.; Alexander Hay, James Tyson and M. J. Madison. Ranton Boiler Co., Syracuse, N. Y.; $25,000; Wm. J. Ranton, Charles T. Bfockway and George West. Savannah Tank & Supply Co., Savannah, Ga.; to manufacture oil tanks, etc., and deal in oils, turpentine, etc.

CURRENT PRICES.

RAILS.—New York: $30 at eastern mills, $39.75 at tidewater; old rails, $16.50 to $17 for iron and $14 to $14.50 for steel. Pittsburg: old rails, $19.50 to $20 for iron and $15 to $16 for steel. Chicago: $31 to $32.50; light rails, $32; old rails, $17.75 for iron and $12.50 to $14.25 for steel.

TRACK MATERIAL.—New York: steel angle bars, 1.6 to 1.65 cts.; spikes, 1.9 to 2 cts.; track bolts, 2.4 to 2.6 cts. with square and 2.7 to 2.8 cts. with hexagon nuts. Pittsburg: splice bars, 1.75 to 1.77 cts. for iron and 1.8 cts. for steel; iron and steel spikes, 2.15 cts.; iron track bolts, 2.7 cts. with square and 2.8 cts. with hexagon nuts. Chicago: splice bars, 1.7 to 1.75 cts. for iron and steel; spikes, 2.1 to 2.15 cts.; track bolts, 2.6 to 2.7 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows at Pittsburg: 60 and 10% and 50 and 10% on black and galvanized butt-welded; 70% and 60% on black and galvanized lap-welded. Casing, 55%.

FOUNDRY PIG IRON.—New York: $14 to $15.50. Pittsburg: $13 to $14.25. Chicago: $13.25 to $14.75.

LEAD.—New York: 4 to 4.05 cts.; Chicago: 3.9 to 3.95 cts.; St. Louis: 3.8 cts.

STRUCTURAL MATERIAL.—New York: beams, 2.2 to 2.5 cts. for large lots, and 2.35 to 2.75 cts for small lots; channels, 2.25 to 2.5 cts.; angles, 1.95 to 2 cts.; tees, 2.3 to 2.75 cts.; sheared iron plates, 1.85 to 2.1 cts.; steel plates, 1.9 to 2 cts. for tank, 2.2 to 2.25 cts. for shell, 2.5 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 1.95 to 2 cts. for large lots and 2.05 to 2.1 cts. for small lots; channels, 1.95 to 2 cts. for large lots and 2.05 to 2.1 cts. for small lots; angles, 1.85 to 1.95 cts.; tees, 2.4 to 2.5 cts.; Z-bars, 2.05 to 2.15 cts.; universal mill plates, 1.8 to 1.85 cts. for steel; sheared steel bridge plates, 2 to 2.1 cts.; refined bars, 1.7 cts. for iron and steel; steel plates, 1.75 to 2 cts. for tank, 2 to 2.25 cts. for shell, 2 to 2.25 cts. for flange, 3.5 to 3.75 cts. for firebox. Chicago: beams, 2.15 to 2.5 cts.; channels, 2.25 cts. to 2.3 cts.; angles, 1.9 to 2.25 cts.; tees, 2.25 to 2.4 cts.; universal plates, 2.05 to 2.15 cts.; steel plates, 2.1 to 2.4 cts. for tank and 2.45 to 2.75 cts. for flange.